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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison on Hudson, N. Y.

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*METEOROLOGY IN THE UNIVERSITY.**

THE atmosphere presents to us a purely material and mechanical aspect, and it is this which rivets the attention of the physicist properly so-called. He views the storm thundering over his head, the floods devastating the earth, the droughts destroying the crops, the hurricane lashing the ocean, and asks, is there not order and law in the midst of this confusion? It is for such a physicist, for the meteorologist proper, for him who would understand the daily weather map and would predict the weather from day to day on a rational basis, as the engineer predicts the performance of his unbuilt engine or the chemist the behavior of some novel untried combination, that I would plead. Such a student needs a collegiate course that shall fully recognize dynamic meteorology as one of the subjects in which candidates for the degree of 'Doctor of Philosophy' may prepare for examination. Thus you will solve the problem as to what

*An extract from a report presented in 1893 to President Seth Low, of Columbia College, recommending the establishment of courses in meteorology and a meteorological laboratory in connection with the University.

Columbia College can do to provide for the meteorological needs of this country. The mere statement of these subjects—the three lines of type that show the student what he may study if he will—serves as a sufficient stimulus, if his bent is in that direction.

I maintain that there is a real demand for a broad course of instruction in meteorology and that there is an abundance of work to be done, both mathematical and experimental. The courses and the laboratory work that bear on the study of the atmosphere are almost the same as those that one would naturally take up if one were preparing to be a hydraulic engineer. The fundamental question to be resolved in the study of the mechanics of the atmosphere consists in determining what the general motions of the air must be under the influence of gravitation and the rotation of the earth; of evaporation and condensation of moisture; of absorption and radiation of heat, and of the irregularities of oceans and continents, hills and valleys. If there were no solar heat the temperature would be fairly uniform at all altitudes, the earth and the sea would be frozen, there would be no clouds, and the atmosphere would be a stagnant layer revolving with the globe to which it adheres.

Professor William Ferrel, a native of Pennsylvania, was the first to solve approximately the equations of motion and deduce some of the phenomena which as observation shows actually exist. He proved that any free body in motion on a rotating surface would be deflected to the right in the northern hemisphere, and that a pressure in that direction would therefore accompany any effort to make the body move in a straight line. In consequence of this deflection a belt of low pressure must exist around the earth at the equator and areas of low pressure at the poles with special areas of high pressure at the tropics. Among the equations of fluid motion Ferrel included the 'equation of continuity' so-called, but found that the general solution of the problem as thus stated analytically was impracticable; he therefore took as a special solution the observed pressures and temperatures all over the globe and showed what the relative motions must be both for the lower winds and the upper atmospheric currents. He then proceeded to a discussion of the temperatures, pressures and winds that must be experienced within a region of abnormally high or low pressure, such as we now call cyclones or anticyclones. He derived the formula connecting the intensity of the barometric gradients with the winds that cut across them diagonally.

Ferrel's next memoir took up the thermodynamic problems, especially those that Espy had seen to be important factors in the development of our thunderstorms, showing that ascending air expands and by virtue of its expansion is cooled throughout its whole mass to an extent easily calculated by the laws of thermo-dynamics, and that when cooled below the dew point a formation of fog and cloud must result, giving rise to an evolution of heat and a delay in the cooling process, so that the moist air is warmer than the dry air would have been. Thus a cloud once formed becomes a center of aspiration, so that clouds and storms grow as long as they are supplied with uprising currents of moist air. Ferrel reduced to formulæ and figures the general doctrines of Espy and showed them to be perfectly applicable to a certain class of our storms, namely, those in which the ascent of air is sufficiently rapid to render the radiation of heat and the mixture with surrounding air matters of secondary importance.

The general treatise of Professor Ferrel entitled 'Recent Advances in Meteorology,' published by the Signal Office in 1885, gives most of his earlier results with many revisions and new ideas.

Very similar results were published by Oberbeck in 1882 and 1888, employing more elegant mathematical methods and advancing a step beyond Ferrel's first publications. It may, however, be stated that the general solution of the hydro-dynamic equations presupposes a definite knowledge of the distribution of temperature or of density in the atmosphere; and, of course, the solutions given by Oberbeck and Ferrel are intended to apply only to the atmosphere as we observe it.

The thermo-dynamic phenomena attending the ascent and descent of the air have been treated analytically by many authors, such as Sir William Thomson, Reye, Chambers, Hann, Guldberg and Mohn; within the last few years this subject has been worked out in a very elegant, graphic way by Herz and von Bezold.

The memoir of Herz considers only adiabatic changes, while the memoir of Bezold considers the changes that are not strictly adiabatic. It is evident on a slight consideration that the quantity of heat within a given mass of air is continually changing by reason of several processes: *First*, the direct absorption from the sun; *second*, radiation to colder objects; *third*, the loss by convection of heat attending the precipitation of rain or snow; *fourth*, the gain by convection attending evaporation from the earth into the air; *fifth*, the process of mixture that is constantly going on. Therefore atmospheric processes are by no means always adiabatic, and Bezold's graphic methods enable us quickly to solve any problem that may be presented. Bezold and Helmholtz have agreed in adopting and recommending the term 'potential temperature' as defining the temperature that a mass of gas would have if brought to a normal pressure, without loss or gain of heat.

Helmholtz added to our knowledge of atmospheric movements by his studies on the conditions of stability among masses of air that have a discontinuous motion, such as two vortex rings encircling the earth in different latitudes and having different temperatures. In general, stable equilibrium is possible only when the warm ring is on the polar side of the cold ring.

A pupil of Helmholtz, Professor Diro Kitao, of the Imperial Academy of Agriculture of the University of Tokio, has made an elaborate study of the forms of motion that attend the meeting of two horizontal currents, which then pile up and roll back on themselves.

Finally, Helmholtz has given us very remarkable memoirs on waves in the atmosphere and the distribution of energy in the winds and the ocean waves. Moeller, Sprung, Hann, Wien and others have elaborated the ideas thus contributed.

The so-called 'convection theory of storms' that we call Espy's assumes that the latent heat of vapor is the maintaining power and that the original ascent of the moist, warm air is due to its buoyancy. Therefore we could have no continued cyclonic motion without ascending moisture and clouds and rain. But the other studies have, I think, put it beyond doubt that there is another equally important cause at work, which undoubtedly is the fact that the upper air flowing northward from the equator as a return trade is slowly cooling by radiation and descending. It eventually reaches the earth here and there in spots which are small areas of clear sky in the tropical regions, but are large areas of cold dry air and high pressure in northern latitudes. If the air is cooled by radiation faster than it is warmed up by the compression attending its slow descent, then it descends as clear, cold and dry air, and only after reaching the earth's surface does it begin to warm up again in the daytime faster than it can cool at night. As this dry cold air under-runs the moist, warm air at the

earth's surface, or as two areas of high pressure flowing toward each other must lift up the lighter air between them and set it into cyclonic rotation, we must, therefore, recognize the general conclusion that Espy's aspiration cyclone as developed by Ferrel is not the only form of cyclone, but that those due to descending cold air and, therefore, having the general circulation of the atmosphere as their fundamental cause are equally entitled to consideration.

To this last and latest development from the theoretical side I need only add that the study of the motions of the clouds has enabled me to assert confidently that there is no form of motion known to the student of the mechanics of fluids but what is to be found beautifully illustrated in some important phenomenon of the atmosphere. I may give one illustration of this statement.

All have seen the beautiful standing waves on the surface of a little stream of water flowing over a rocky bed. The theoretical study of these waves began with Bidone early in this century and has been especially prosecuted by Bazin and Boussinesq in France and Sir William Thomson in Scotland. Precisely similar waves must occur in the atmosphere, but can only become visible to us by the formation of clouds at the summit of each wave if the air rises high enough. Invisible standing waves exist over our heads all the time. It was my good fortune to make an extensive series of observations on a remarkably well developed system of standing waves capped by clouds, which perpetually extend from the summit of Green Mountain, on the Island of Ascension, to the leeward for a hundred miles under the influence of the steady southeast trade wind. These become invisible when the air becomes a little cooler or dryer, and consequently they actually disappear every night only to reappear as regularly every day.

But I need not dwell any longer on the relations of the theoretical and the actually observed motions of the atmosphere. Our interest in the meteorological or dynamical theories and their application to the atmosphere is not inferior to our interest in any other physical science.

The possibility of making accurate long-range predictions of the weather and the seasons is recognized as an ultimatum that should fire the zeal of every young physicist.

Meteorology has advanced far beyond the stages of observation and generalization. It has had its Newton, Laplace, Dove, Espy, Forrel, Oberbeck, and Helmholtz and Thomson. As an application of mathematical physics it outranks all other branches of science in its universal importance and its difficulty. Why should it not be recognized as worthy of study in our universities?

Course of Instruction in Meteorology.

The following courses in the Department of Meteorology are designed to give a complete review of the present condition of that science, and are therefore necessarily extended through four years; but the series of lectures is so arranged that each of the four divisions is complete within itself; each course presents a view of a branch of the subject such as may be desired by a large number of students who need this information in connection with other branches of knowledge to which they are specially devoting themselves.

Students who intend to take the degree of Ph. D. in meteorology, and who therefore make this the major subject in connection with several other minor courses, must pursue the whole four years' course. Those who merely desire to understand observational meteorology will probably find the first year's course sufficient. Those who desire to do original work in climatological study should also take the second year.

The third year's course is designed for those who wish to perfect themselves in methods of making local weather forecasts. Finally, the fourth year's course summarizes the present state of our knowledge of the mechanics and physics of the atmosphere.

FIRST YEAR.—Observational Meteorology. The methods of observation; the simpler instruments, their errors, corrections and reductions; the theory and use of self-registers; the forms of record and computation; personal diary of the weather.

Time.—About eighty lectures, or two hours a week, as also eighty other hours of personal investigation of instruments and their exposure.

Concomitant Studies.—Algebra and trigonometry are the necessary preliminaries to this course. Elementary laboratory physics, as illustrated by Hall and Berger's text-book, is desirable as a preliminary, but may be pursued as a concomitant study. The German language is earnestly recommended as a concomitant. The differential and integral calculus should be studied as preliminary to the fourth year.

SECOND YEAR.—Climatology, both local and general; statistical meteorology, generalizations, averages, periodicities, irregularities. The relations of climate to geology, to vegetation, to animal life, and to anthropology.

Time.—About forty lectures and four hours weekly given to the investigation of special problems proposed in each lecture.

Concomitant Studies.—Students should familiarize themselves with the use of logarithms; the method of least squares; the laws of chance; the details of physical geography, orography, geology and ocean currents; the physiology of plants and animals; the distribution of species; physical astronomy, especially that of the earth, sun and moon; terrestrial magnetism; the chemistry of the atmosphere; the biology of atmospheric dust. Physical laboratory work on radiation, conduction and absorption of heat, on the condensation and evaporation of vapor, and on elementary electricity, is recommended. The study of German, the calculus and analytic mechanics should be continued as preliminary to the remainder of the Course.

THIRD YEAR.—Practical Meteorology; the daily weather chart; the empiric laws of weather changes as dependent on meteorological data and on the arrangement of continents, plateaus, mountains, oceans, etc.; weather types and typical weather charts; predictions of daily weather storms and general predictions of seasonal climates; verification of predictions.

Time.—About forty lectures and about five hours a week additional in verifying predictions.

Concomitant Studies.—Methods of chart projection; experimental laboratory work in both steady and discontinuous motions of fluids and gases; mathematical and experimental electricity; the laws of refraction and interference of light; elementary hydrodynamics and thermo-dynamics; differential equations and definite integrals; the German language.

FOURTH YEAR.—Theoretical Meteorology. Insolation. The absorption, conduction and radiation of heat by the air and by the earth. The thermo-dynamics and physics of the atmosphere; the graphic methods of Herz and Bezold. Convective equilibrium, as applied to the atmosphere of the sun by Lane, and to that of the earth by Sir William Thomson (Lord Kelvin), and their successors. Motion on a rotating globe; Ferrel's and other simple approximate relations between baric gradients and the wind and temperature; Ferrel's general circulation of the atmosphere and his cyclones and pericyclones and tornadoes. Galton's cyclone and anti-cyclone. Fourier's most general equations of gaseous motions,

Oberbeck's general circulation. Helmholtz' horizontal rolls. The investigations of Diro Kitao, Guldberg and Mohn, Marchi, Boussinesq, A. Poincaré, Sprung, Siemens, Moeller, Ekholm, Ritter, Lindeloff, Margules and Hermann into the motions of the atmosphere. Viscosity and discontinuity. The possible special solutions of the general equations of fluid motions that apply to the true atmospheric circulation, both on the earth and on the other planets. Atmospheric tides; theories of Laplace, Ferrel, Rayleigh, Margules, A. Poincaré. Theories of atmospheric electricity.

Time.—Eighty lectures and an additional four hours a week given to special reading and investigation and to the preparation of the final thesis, as closing the four years' course.

Concomitant Studies.—Riemann's *Differential Gleichungen:* Auerbach's *Hydrodynamics;* Lamb's *Hydrodynamics* (new edition); physical laboratory work in gaseous motions, optical and electrical phenomena.

THE METEOROLOGICAL LABORATORY.

In order to carry out an ideal course in meteorology it is necessary to not merely study lectures and text-books but the current daily weather maps; to practice the use of instruments and to keep weather records; to investigate special questions in local climatology, and to personally explore the atmosphere.

In the meteorological laboratory the student should investigate experimentally questions that arise in relation to the motions of the atmosphere, which includes almost every pertinent form of experiment in the motions of fluids and gases. Provision should also be made for the study of such optical phenomena of the atmosphere as refraction, absorption, interference, scintillation, mirage, and sunset colors.

This laboratory should also provide for study and practice with self-registers, the study of the thermo-dynamics of the air and aqueous vapor; the determination of the amount of heat received from the sun; the continuous records of atmospheric electricity, terrestrial magnetism, earth currents, the tides and earthquakes.

The laboratory should also provide mathematical apparatus or mechanical devices by which complex questions in the motion of the atmosphere may be solved.

Facilities should be given for the study of atmospheric dust, especially in its relation to the temperature of the air and to the formation of clouds and rain.

The laboratory should contain a working library and bibliography.

Cleveland Abbe.

Washington, D. C.

GEOLOGIC ATLAS OF THE UNITED STATES.

FOLIO 1, LIVINGSTON, MONTANA, 1894.

This folio consists of 3¼ pages of text, a topographic sheet (scale 1:250,000), a sheet of areal geology, one of economic geology, one of structure sections, and one of giving a columnar section. The text is signed by Joseph P. Iddings and Walter H. Weed, geologists, and Arnold Hague, geologist in charge.

The area of country covered by the folio lies between the parallels of latitude 45 and 46 and the meridians 110 and 111, and embraces 3,340 square miles. It is within the State of Montana, including portions of Gallatin and Park counties, and the town of Livingston is within its limits. The region is elevated, the lowest point being over 4,000 feet, the major portion over 6,000 feet, and the highest peaks over 11,000 feet above sea level.

The principal topographic features are the Snowy Mountains, Gallatin Range, Bridger Range, Crazy Mountains and Yellowstone Valley. The Yellowstone River is the main drainage channel for the area. It enters the district from the Yellowstone

Park about the middle of the southern border, flows northwest and north through a closed valley 30 miles long and three miles wide, and at Livingston turns northeast and enters the broad open valley beyond the frontal ranges of the Rocky Mountains.

The rocks forming the surface of the country are partly crystalline schists, including gneiss, schists, with granite and other granular rocks; partly sedimentary formations, including limestone, sandstone and shales; and partly lavas and other igneous rocks. The crystalline schists are mainly Archean and constitute a large part of the southern half of the region. They form the higher mountains and plateau drained by Boulder River and those from Emigrant Peak south. A small area of sandstones, conglomerates, slates and arenaceous limestones occurring in the Bridger Range have been referred to the Algonkian. They lie unconformably upon the crystalline schists, and are overlain unconformably by the Paleozoic series.

The sedimentary formations cover one-half the area, and present a total thickness of 20,000 feet, embracing all the grand divisions of geologic time since the Archean. The chief feature is the great development of the latest Cretaceous strata, which are 12,000 feet thick above the Laramie, the total thickness of the Paleozoic being only 3,500 feet. The series from the basal (Flathead) quartzite to and including the Laramie coal beds is conformable throughout. The Paleozoic strata occur upturned at steep angles against the crystalline schists or in steep anticlines. The lowest bed is the Flathead quartzite. Above it are shales and limestones of Cambrian age. The Silurian is represented by only a few feet of formation, whose precise age is doubtful. Four hundred and fifty feet of shales and limestones represent the Devonian. The Carboniferous strata are 2,000 feet thick. They are here, as elsewhere, the mountain limestones and form the crest of the Bridger Range and the summits of some peaks of the Snowy Range. The Trias is recognized only in the southern part of the region, as thin belts of red sandstone. The Jura varies considerably in character, being mostly shales and fissile limestones. These two formations are 500 feet thick.

The Cretaceous constitutes more than one-half of the total thickness of strata. Its lowest member is the Dakota conglomerate with sandstone and some shale. Over this is the Colorado group, including Benton shales and Niobrara limestone, aggregating 1,800 feet in thickness. Over this is the Montana group, 1,800 feet thick, consisting of Pierre shales and Fox Hills limestones. The Laramie sandstone, with some intercalated clays and beds of coal, is 1,000 feet thick. Above this is a slight unconformity, followed by conglomerates, sandstones and clays of the Livingston formation 12,000 feet thick. Near the base the conglomerate consists largely of volcanic material. True tuff-breccia of volcanic rocks occurs intercalated near the base of the series on Boulder River.

Neocene lake beds occur in Gallatin Valley, and on Yellowstone River opposite Fridley.

Surficial deposits of the Pleistocene period occur as alluvium over all the broader river valleys. Glacial drift, consisting of gravel, sand and boulders, is scattered over the higher parts of the country and covers the Yellowstone Valley south of Chicory.

Igneous rocks occupy a large part of the area of this sheet. They consist of subaerial breccias or agglomerates with tuffs and lava flows and of intrusive bodies, such as dikes, sheets, laccolites and stocks or necks. They occur extensively in the southeastern corner of the district and form the Gallatin Range along the south-

western border and another area east of Boulder River.

In the Crazy Mountains the igneous rocks are wholly intrusive. The extrusive rocks are andesitic breccia, acid and basic; trachytic rhyolite and basalt. The intrusive rocks are gabbro, diorite,theralite, basic and acid porphyrties, basic and acid andesites, and dacites. Several centers of volcanic eruptions, active in early Tertiary time, occur in the region. They are at Emigrant Gulch, Haystack Mountain and Crazy Mountains. Other centers are just outside of the limits of the atlas sheet.

The chief economic deposits of the district are the gold-bearing gravels of Emigrant, Bear and Crevice Gulches. They have been worked on a small scale. Gold veins occur in Emigrant Gulch, Crevice Gulch and Haystack Mountain. Copper ores in small quantities have been found at the head of Boulder River and of Slough Creek. Clays serviceable for brick-building occur in the alluvium near Livingston and in the lake beds near Bozeman, also in the Cretaceous strata. Two coal fields exist within the district, the Cinnabar field and the Bozeman field. The aggregate thickness of the seams is from 12 to 18 feet, made up of a number of seams, only three of which are workable. The coal is bituminous, of variable character, and in places is a fair coking coal. The output in 1889 was 49,400 tons.

FOLIO 3, PLACERVILLE, CALIFORNIA, 1894.

This folio consists of 1½ pages of text descriptive of the Gold Belt and 1½ pages descriptive of the Placerville district, signed by Waldemar Lindgren and H. W. Turner, geologists, and G. F. Becker, geologist in charge; a topographic map (scale 1:125,000) of the district, a sheet showing the areal geology, another showing the economic geology, and a third exhibiting structure sections.

Geography.—The territory represented lies between the meridians 120° 30′ and 121° and the parallels 38° 30′ and 39°, and contains 925 square miles. It is located in the upper foothill region of the Sierra Nevada, the elevation ranging from 300 feet to 5,400. The prevailing character of the topography is that of irregular and undulating plateaus, cut by deep canyons and steep ravines. The district is drained by the three forks of the American River in the northern part and by the three forks of the Cosumnes River in the southern part.

Geology.—The eastern half of the tract is principally composed of a somewhat metamorphosed sedimentary series, the Calaveras formation, of presumable Carboniferous age. The rocks consist chiefly of clay slates and quartzitic sandstones, and have in general a northerly strike and steep easterly dip. Several irregular intrusive masses of granitic rocks are contained in the sedimentary series. The western half of the tract is much more complicated. A belt of black slates belonging to the Mariposa formation, of late Jurassic age, traverses the tract from north to south. To the west of this belt follow again sedimentary rocks of the Calaveras formation, greatly cut up by igneous rocks. The sedimentary rocks here, as well as in the western part, have a northerly strike and steep easterly dip. The western part of the area contains a great abundance of basic igneous rocks, consisting of diabase, augite, hornblendic porphyrite, gabbro-diorite, pyroxenite and serpentine. Over large areas certain of these basic rocks have been converted to amphibolitic schists by dynamo-metamorphic processes. Covering the ridges and resting unconformably on the older rocks are large masses of Neocene effusive rocks, chiefly tuffs and breccias of rhyolite and andesite. These masses form gently sloping tables, underneath which the Neocene gravel channels are found.

Economic Geology.—The Neocene River channels, with very highly auriferous gravel, are exposed and mined at several places in the area, for instance, at Todd's Valley, near Georgetown, and in the vicinity of Placerville. Many and important auriferous quartz veins are found in the area. The principal ones occur along the belt of Mariposa slates previously mentioned, and form the northern end of what is usually referred to as the Mother Lode of California. Passing by Nashville and Placerville, the vein is almost continuous up to the northern part of the area, where it splits up into several branches, which die out before reaching the northern border. Important veins are, however, also found both to the east and west of this belt. Near the eastern line lies the important mining district of Grizzly Flat.

There are practically no alluvial soils in the area. The deep soil on the summit of the ridges is always a residual soil, formed by the decomposition of the rocks in place.

FOLIO 5, SACRAMENTO, CALIFORNIA, 1894.

This folio consists of 1½ pages of text descriptive of the Gold Belt and 1½ pages descriptive of the Sacramento tract, signed by Waldemar Lindgren, geologist, and G. F. Becker, geologist in charge; a topographic map (scale 1:125,000) of the tract, a sheet showing the areal geology, another showing the economic geology, and a third exhibiting structure sections.

Topography.—The Sacramento tract includes the territory between the meridians 121° and 121°30′ and the parallels 38°30′ and 39°, and contains 925 square miles. The western half of the tract embraces a part of the Sacramento Valley, while the eastern half contains the first foothills of the Sierra Nevada. The elevation ranges from 30 feet above sea level at Sacramento to 2,100 feet in the northeastern corner of the tract. The foothill region forms a sloping and undulating table land, through which the American River has cut a deep and narrow canyon.

Geology.—A small area of sedimentary slates of the Calaveras formation (Carboniferous) occurs in the northeastern corner, and a belt of black clay slates belonging to the Mariposa formation (late Jurassic) is contained in the igneous rocks of the southeastern part. At Folsom the Mariposa slates are cut off and contact metamorphosed by the granitic rocks of the Rocklin massif. The larger part of the older rocks of this tract is of igneous origin. A large area of diabase and porphyrite is found along the eastern margin. Wide belts of these rocks have been rendered schistose and changed to amphibolites by dynamo-matamorphic processes. Several masses of granodiorite and gabbrodiorite have been intruded into the diabases, porphyrites and amphibolites. Small masses of serpentine are sometimes found in the amphibolite; others appear intimately connected with gabbrodiorite.

Superficial flows of andesitic tuffs and breccias cover the older rocks. The larger part of these flows has been eroded. The remaining masses form sloping tables in the lower foothill region. Auriferous gravel channels are found in places below these volcanic rocks. At an elevation of 300 feet the andesite is underlain by clays and sands of the Ione formation, deposited in the gulf which in Neocene times skirted the foothills of the Sierra Nevada. The western part of the tract is largely covered by early Pleistocene deposits of gravel, sand and hardpan.

Economic Geology.—Neocene auriferous gravels have been worked to some extent east of Rocklin and south of Auburn. The Pleistocene gravels in the foothills have been very rich in gold, but are now mostly exhausted. At Folsom large masses of Pleistocene gravels are still worked. Auriferous quartz veins have been extensively

worked between Ophir and Auburn. Small veins are occasionally worked near Clarksville and in the vicinity of Pilot Hill.

The central mass of granodiorite affords excellent building stone. Limestones occur chiefly as lenses in amphibolite at many places along the eastern border. The soils of the foothill region are residuary in character, while the western part of the tract is occupied by deep alluvial and sedimentary soils.

FOLIO 7, PIKE'S PEAK, MONTANA, 1894.

This folio consists of 4½ pages of text, signed by Whitman Cross, geologist, a topographic sheet (scale 1:125,000), a sheet of areal geology, one of economic geology, and one of structure sections, followed by a special description of the Cripple Creek mining district, consisting of 1 page of text on the mining geology by R. A. F. Penrose, Jr., and a map (scale 1:25,000) showing the economic geology of the district.

Geography.—The district embraces an area of 931.5 square miles between the meridians 105° and 105° 30′ and parallels 38° 30′ and 39°. In the eastern half of the district lies the crest of the granitic Colorado Range, which extends from Manitou Park through Pike's Peak to the southern end of the range, where it sinks to the level of the plains. The western portion of the area is a plateau, of granite and volcanic rocks, lying between 8,000 and 10,000 feet in elevation, penetrated on the south by deep canyons of streams tributary to the Arkansas River and by the recess or bay of Garden Park, nearly at the level of the plains. The principal drainage of the district is by tributaries of the Arkansas River, which flows through the Royal Gorge just beyond the southern boundary. The remaining drainage is into the Platte River, which cuts across the northwestern corner of the area in a deep canyon.

The Colorado Midland Railroad traverses the district from east to west near its northern boundary. East of the center of the area is the mining district of Cripple Creek, reached by branch railroads from the north and south.

General Geology.—The granites of the mountain and plateau regions are reddish in color, coarse or fine grained, and similar to those of many other regions in Colorado. Of special interest is the observation, first made by the survey corps, that these granites contain many large and small fragments of metamorphosed stratified rocks, quartzites and schists belonging to the oldest series of sedimentary beds, the Algonkian, and hence the granites are not of Archean age, as has previously been assumed. Most, if not all, of the gneisses in this district have been formed from the granites by a shearing strain, as is very clearly demonstrated in many places.

The sedimentary formations of the area and their characteristics of special interest may be concisely referred to as follows:

Algonkian. Nearly 4,000 feet of white quartzite, in small part conglomeritic, is shown in the huge inclusion in granite in Wilson Park. These ancient strata are not known in this region except as inclusions.

Silurian. Three divisions of the Silurian strata, each about 100 feet thick, have been recognized in Garden Park, and named respectively the Manitou limestone, Harding sandstone and Fremont limestone. The Harding sandstone contains the oldest fossil fishes as yet known. Minor unconformities separate these formations, and they are not known in so good development elsewhere.

Carboniferous. Resting on the Silurian is a thin limestone, called the Millsap, carrying a few Carboniferous shells, and known only in small remnants. The red sandstones and grits of Manitou and Garden Parks, 1,000 feet in thickness, are considered as of Carboniferous age and named

the Fountain formation. No fossils are known in them.

The strata of the Juratrias and Cretaceous have been found in remnants upon the granite plateau, indicating a former extension of these beds connecting with South Park.

Eocene. The small lake deposit about Florissant is noted the world over for its fossil insects, while fishes, birds and many plants are also found in these thin beds, which are chiefly made up of volcanic ashes.

The volcanic rocks of the district are numerous and interesting. Those of the western portion belong to a great volcanic center south of South Park. At Cripple Creek is a local volcanic vent, the peculiar product of which is the rare rock phonolite.

Many points in the geological history of the Colorado Range have been brought out by the recent survey, such as the evidence of varying relations between land and sea at different periods, shown by unconformities and by remnants of strata on the granite plateau. The shear zones shown by the gneisses, and the observed folds and faults of the foothills, bear directly upon the structural history of this portion of the Rocky Mountains.

Economic Geology.—The gold-bearing district of Cripple Creek is directly connected with the volcanic center. The gold ores are free milling near the surface, but pass into telluride smelting ores in depth. They occur in veins, chiefly in the volcanic rocks, but occasionally in the granite near them. The extreme alteration of the rocks of the eruptive center, and the unusual character of the gold veins, have made a detailed study of the mining district necessary. A special topographic and geologic map on the scale $\frac{1}{2500}$, or nearly $2\frac{1}{2}$ inches to the mile, has been made, and the ore deposits have been thoroughly examined by Prof. R. A. F. Penrose, Jr.

FOLIO 9, ANTHRACITE–CRESTED BUTTE, COLORADO, 1894.

This double folio consists of 3 pages of text descriptive of the Elk Mountains, by S. F. Emmons; 2 pages descriptive of the igneous formations of the two districts, by Whitman Cross; 4 pages descriptive of the sedimentary formations, by G. H. Eldridge; of each of the two districts a topographic map (scale 1:62,500), a map of areal geology, another of economic geology, and a third of structure sections; and finally, a sheet showing a generalized columnar section for the two districts.

Geography.—The combined area represented on the two sheets covers one-eighth of a degree, lying between the parallels 38° 45′ and 39° and the meridians 106° 45′ and 107° 15′, and is about $27\frac{1}{2}$ miles long from east to west and $17\frac{1}{2}$ from north to south. It includes the southern third of the Elk Mountain group, which lies between the Sawatch Range on the east and the plateau of the Colorado basin on the west. It is a highly picturesque and mountainous region, and, like the San Juan Mountains to the south, has a more abundant precipitation and is more alpine in its character than other parts of the Rocky Mountains.

The northern half of the eastern or Crested Butte tract is occupied by the southern portion of the Elk Mountains proper, whose culminating points have an elevation of over 13,000 feet; the southeastern portion of that tract includes the distinct and less elevated Cement Mountain uplift. The rest of this area and the whole of the Anthracite tract is occupied by more or less isolated mountain peaks—Crested Butte, Gothic Mountain, Mount Wheatstone, etc., and by one prominent north-and-south ridge, the Ruby Range, whose higher summits rise between 12,000 and 13,000 feet above sea level.

The drainage of all this area finds its

way through the Gunnison River into the Colorado, and the greater part is carried to the latter stream through the southward-flowing Slate River and its tributaries.

The towns of Crested Butte (9,000 feet) and Baldwin (8,750 feet), which are near active coal mines, are reached by branches of the Denver and Rio Grande and the Denver and South Park railroads respectively. Other towns higher in the mountains, which were founded by silver miners, are Gothic, Pittsburg and Irwin. Owing to its great altitude and abundant precipitation, this region is more or less snow-bound during eight months of the year, and mining is thereby rendered difficult and costly.

Geologic Structure.—The most striking feature in the geology of the region is the great development of eruptive rocks which occur: as irregular bodies cutting across disturbed and upturned strata; as laccolitic bodies doming up the nearly horizontal strata above a given horizon; as vertical and comparatively narrow dikes; to a limited extent as surface flows; and as a bedded series of breccias, tuffs and conglomerates.

Eruptive activity was most energetic and widespread during the Eocene Tertiary; it continued, however, sporadically, during later periods, the most recent outpourings of lava being probably of Pleistocene age. The principal rock types represented are: in the irregular cross-cutting masses, granite and diorite, and at a later period and in limited areas, rhyolite; the laccolites are mostly of porphyrite; among dike rocks are found diorite, porphyritic diorite, porphyrite and quartz porphyry; basalt occurs as a surface flow, and andesitic debris in the tuffs and conglomerates of the bedded series.

Among sedimentary rocks in this region are found representatives of the principal formations from the Archean up to the close of the Mesozoic, with some later formations whose exact age is still somewhat doubtful. The Cambrian is represented by the Sawatch quartzite, which consists of 50 to 200 feet of white quartzite, conglomeritic at the base, and at certain horizons persistently glauconitic; its fossils are of the Potsdam type.

The Silurian beds, which are locally called the Yule limestone, in an aggregate thickness of 350 to 450 feet, consist mainly of limestones, with quartzite at the base and more shaly beds at the top. They contain the same fish remains that characterize the Harding sandstone of the Canyon City section, but organic remains have not been discovered in sufficient abundance to admit of the subdivision of the series on a paleontologic basis.

The Carboniferous is represented by three subdivisions. (1) The Leadville limestone, or Lower Carboniferous, has a thickness of 400–525 feet of dark gray or blue limestones, with some intercalated quartzites and shales. Above this is (2) the Weber formation, which consists of 100–500 feet of shales and limestones, carrying fossils of Coal Measure type. The upper member, known as (3) the Maroon conglomerate, consists mainly, as its name indicates, of conglomerates, which are characterized by the local abundance of pebbles of limestone. It has an observed maximum thickness of 4,500 feet, and in its upper portion resembles lithologically the Red Beds, generally assigned to the Trias.

The Juratrias, whose beds are separated from the last mentioned by a great unconformity, is represented by the Gunnison formation, which consists of a heavy white sandstone, about 100 feet in thickness, overlain by shales and a little limestone, and carries a fresh water-fauna of supposed Jurassic age.

The Cretaceous is represented by five recognized subdivisions: The Dakota

quartzite, 50–300 feet thick; the Benton shale, 150–300 feet thick; the Niobrara limestone, 100–200 feet thick; the Montana formation, comprising the Pierre shales and Fox Hills sandstones, 600–2,000 feet thick; the prevailing lithologic characteristics of each of which are indicated by its name. Among later beds are the Ohio formation, about 200 feet of sandstones and conglomerates, and the Ruby formation, with a maximum thickness of 2,500 feet of sandstones, shales and conglomerates made up to a large extent of eruptive debris. These formations are separated by an unconformity from the underlying Laramie, and to the west of this area pass beneath the beds of the Wasatch Eocene; in the absence of fossil evidence they have been classed as Cretaceous.

The geologic structure of this region affords evidence of no less than four important orographic movements, involving the making of new land, the erosion and planing down of the same and the inauguration of a new cycle of sedimentation, which account for the great variation in thickness of certain formations. First, during Post-Archean time, the first deposits, after which were Upper Cambrian (Sawatch quartzite); second, during Carboniferous time, followed by deposition of Weber shales and Maroon conglomerates; third, during Mesozoic time, followed by deposition of the Gunnison sandstone; and fourth, after Laramie time, followed by the Ohio, Ruby and Eocene formations.

Mineral Resources.—The most important economic product of the region is its coal, which is found in the lower part of the Laramie Cretaceous formation, between beds of sandstone. The quality of the coal varies, according to local conditions more or less favorable to metamorphism, from dry bituminous, through coking coal, to semi-anthracite and anthracite. Next in importance are its silver ores, which occur for the most part in true veins or fault fissures in all varieties of rock, but mainly in the sedimentary beds of upper horizons near eruptive rocks. The ores are generally rich, but in small bodies, and, in consequence of natural obstacles to cheap mining, have not been extensively worked. Gold has been found in paying quantities in the alluvium of a single gulch; lead and copper are accessory products in limited amounts.

FOLIO 10, HARPER'S FERRY, VIRGINIA, MARYLAND, WEST VIRGINIA, 1894.

This folio consists of 4 pages of descriptive text, signed by Arthur Keith, geologist; 1 page of columnar section, a topographic map (scale 1:125,000), a sheet showing the areal geology of the district, another showing the economic geology, and a third exhibiting structure sections.

The folio describes that portion of the Appalachian province which is situated between parallels 39° and 39° 30′ and meridians 77° 30′ and 78°. The tract contains about 950 square miles and falls within Washington and Frederick counties, Maryland; Loudoun and Fauquier counties, Virginia; and Jefferson county, West Virginia.

The folio begins with a general description of the province, which shows the relation of the Harper's Ferry tract to the whole. Then the local features of the drainage by the Potomac and Shenandoah rivers and their tributaries (Goose, Antietam and Catoctin creeks) are treated. The various forms of the surface are pointed out, such as Shenandoah Valley, Blue Ridge and Catoctin Mountain, and their relations to the underlying rocks are made clear.

Under the heading Stratigraphy the geologic history of the Appalachian province is presented in outline, and the local rock groups are fully described in regard to composition, thickness, location, varieties, and mode of deposition.

The formations range in age from Algonkian to Cretaceous, the greater portion being Algonkian, Cambrian and Silurian. The Silurian rocks appear in the Shenandoah Valley, the Cambrian in Catoctin Mountain and Blue Ridge, the Algonkian between these ridges, and the Jaratrias east of Catoctin. The Algonkian rocks are chiefly granite and epidotic schist; the Cambrian rocks, sandstones and shales, passing up into limestones; the Silurian rocks, limestones and shales; and the Juratrias rocks, red sandstone and shale and limestone conglomerate. The details of the strata are shown in the columnar section. The manner in which each kind of rock decays is discussed, and how the residual soils and forms of surface depend on the nature of the underlying rock.

In the discussion of Structure, after a general statement of the broader structural features of the province, three methods are shown in which the rocks have been deformed. Of these the extreme Appalachian folding is the chief; next is that developed in the Juratrias rocks, and least in importance are the broad vertical uplifts. Three degrees of extreme deformation appear in the Paleozoic rocks—folding, faulting and metamorphism—each being best developed in a certain kind of strata. Between Blue Ridge and Catoctin Mountain the Algonkian or oldest rocks appear on a great anticlinal uplift, with Cambrian rocks on either side. Faults appear chiefly on the west side of this uplift, and metamorphism increases toward its east side. In the Shenandoah Valley the rocks are folded to an extreme degree, and the strata are frequently horizontal or overturned. The Juratrias rocks always dip toward the west, and are probably repeated by faults different in nature from the Appalachian faults. In the sheet of sections the details of the folds and faults appear.

Economic products of this region comprise copper and iron ore; ornamental stones, such as marble, limestone conglomerate and amygdaloid; building stones, such as sandstone, limestone and slate; and other materials like lime, cement, brick clay and road materials. The localities of each of these materials are noted and quarries located on the economic sheet, and the character and availability of the deposits are discussed.

AMERICAN FOSSIL BRACHIOPODA.

The writer has had in preparation since 1886 'A Synopsis of American Fossil Brachiopoda, including Bibliography and Synonymy.' This work, now completed, will appear as one of the Bulletins of the U. S. National Museum and embraces the following chapters: I. Geological Development; II. Brachiopod Terminology; III. Biological Development; IV. Morphology of the Brachia, by Charles E. Beecher; V. Classification; and VI. Index and Bibliography. The following summary, taken from this work, gives some of the more important results obtained, all of which are discussed at length in the work above cited.

In North America there are one thousand eight hundred and forty-six Paleozoic, thirty-seven Mesozoic, and nine Cenozoic species of fossil Brachiopoda. There are one hundred and one species in the Cambrian, three hundred and eleven in the Ordovician, three hundred and twenty in the Silurian, six hundred and fifty-five in the Devonian, and four hundred and eighty-two in the Carboniferous.

This remarkable scarcity of Post-Paleozoic species in America is supposed to be due not so much to the general decline of of the class as to great orographic movements during the close of the Paleozoic, thus producing complete barriers against the introduction of species from other areas. Moreover, few marine sediments are found in them.

Specific differentiation was most rapid in the Ordovician, having exceeded the Cambrian representation more than three times.

Thirty per cent. of all American Paleozoic species had wide geographic distribution, and this is most pronounced in the Devonian and Carboniferous systems. One hundred and twenty-one American species are also found on other continents.

Widely dispersed species are least common in the most primitive order, Atremata, and greatest in the highest orders, Protremata and Telotremata. The difference, however, is but seven per cent.

The order Atremata is represented by one hundred and ninety-six species, or over ten per cent. of the American Paleozoic representation. In the Neotremata it is one hundred and fifty-three, or over eight per cent. The Protremata have seven hundred and thirty-five species, or nearly forty per cent., and the Telotremata seven hundred and sixty-two species, or about forty-one per cent.

The order Atremata is best developed in species and genera in the Cambrian and Ordovician systems; the Neotremata in the Ordovician; the Protremata in the Ordovician, Silurian and Devonian; and the Telotremata in the Devonian. The climax of differentiation is therefore chronologically related to phylogenetic or sequential origin.

Since the four orders of Brachiopoda are present in the Lower Cambrian, ordinal differentiation must have taken place in Pre-Cambrian times. The two more primitive orders, Atremata and Neotremata, have in *Lingula* and *Crania*, respectively, genera with longest life histories. This probably is due not so much to their primitive structures as to their modes of living.

The last order to originate, Telotremata, has the greatest number of generic and superfamily characters and probably also of species.

The last superfamily to appear, *Spiriferacea*, manifests most rapid evolution and is the second one to die out, being preceded by the *Pentameracea*. These two superfamilies are the most highly specialized in the orders to which they belong, and their great specialization may be the cause of their early disappearance.

The trunk families of later origin throughout the class manifest the greatest specific and generic differentiation, the widest specific dispersion, and have species of the largest size and often of longer geologic persistence.

The oldest or most primitive families nearly always have short geologic duration (except *Rhynchonellidæ*), the least generic and specific differentiation, and commonly the individuals are of small size.

The largest of all brachiopods occur in the families *Pentameridæ*, *Productidæ*, and *Spiriferidæ*, at a time when the class was at the height of differentiation.

Large specific size is probably often gradually attained in genetic lines, and is due to favorable food conditions. The gigantic brachiopods always occur in the later developed trunk families, and just before their decline in differentiation.

But eight genera are known to pass from the Paleozoic to the Mesozoic. There are in all three hundred and twenty-one brachiopod genera, two hundred and twenty-three of which are Paleozoic. The Atremata have twenty-six genera; the Neotremata, thirty-one; the Protremata, eighty-seven; and the Telotremata, one hundred and seventy-five.

All brachiopods begin with smooth shells and protegula.

The prodeltidium, or third embryonic shell plate, is known in the Atremata, Neotremata and Protremata. In the Atremata this becomes attached to the dorsal valve, while in the Telotremata it is not apparently developed at all. In the Pro-

tremata it becomes attached to the ventral valve, as in Neotremata. In the two last named orders it modifies the pedicle opening. For this and other ontogentic and morphologic characters Owen's terms Lyopomata and Arthropomata are abandoned. The Atremata and Telotremata are provisionally arranged under the superordinal term *Homocaulia*, and Neotremata and Protremata under *Idiocaulia*.

A true deltidium is present in the *Acrotretacea* of the Neotremata and in the Protremata.

"The cirrated lophophore, or brachia, is alike in the larval stages of all brachiopods. They first develop tentacles in pairs on each side of the median line in front of the mouth (taxolophŭs stage). New tentacles are continually added at the same points, until by pushing back the older ones there is a complete circle about the mouth (trocholophus stage), later becoming introverted in front (schizolophus stage). From this common and simple structure all the higher types of brachial complication are developed through one of two methods: (1) the growing points of the lophophore, or points at which new tentacles are formed, remain in juxtaposition; or (2) they separate. Complexity in the first is produced (a) by lobation, as in *Magathyris*, *Eudesella*, *Bactrynium*, *Thecidea*, etc. (ptycholophus type), and (b) by looping (zuglolophus) and the growth of a median, unpaired coiled arm (plectolophus), as in *Magellania*, *Terebratulina*, etc.; in the second (c) by the growth of two, separate, coiled extensions or arms, one on each side of the median line (spirolophus), as in *Lingula*, *Crania*, *Discinisca*, *Rynchonella*, *Leptæna*, *Davidsonia*, *Spirifer*, *Athyris*, *Atrypa*, etc." [Charles E. Beecher.]

Morphological equivalents, or similar structural features, are developed independently, as follows: A spondylium in *Obolacea*, *Lingulacea*, *Pentameracea*, and rarely in *Spiriferacea*; crural processes in *Pentameracea* and *Rynchonellacea;* functional articulation in Protremata and Telotremata; straight, more or less long, cardinal areas from rostrate forms in *Rynchonellacea*, *Spiriferacea* and *Terebratulacea*; rostrate shells from long cardinal areas in *Pentameracea*; and loss of pedicle and ventral shell cementation in *Craniacea*, *Strophomenacea* and *Spiriferacea*.

Charles Schuchert.

U. S. National Museum.

ASTRO-PHOTOGRAPHIC WORK TO BE CARRIED OUT AT COLUMBIA COLLEGE OBSERVATORY.

One of the great difficulties that has stood in the way of attaining the highest precision in photographic astrometry has been the determination of a possible distortion of the field of the photographic telescope. Some years ago Dr. Gill tried to meet this difficulty by recommending the possessors of photographic telescopes to make a series of pictures of the group of stars he had used as comparison stars for the planet Victoria in his Solar Parallax work. These stars had been very carefully determined, both in the meridian and with the heliometer, so that a mere comparison of the photographic coördinates with the others ought to throw considerable light on the question of the optical distortion of the photographic telescope. This process has been very carefully carried out by Donner, at the Helsingfors observatory. But the result he has secured leaves the matter still in doubt. His determination of the optical distortion of the Helsingfors telescope by Gill's method does not possess sufficient weight. The cause of this partial failure of Gill's method must be sought in the unfavorable distribution of the Victoria stars for the purpose in question, in the small remaining errors of Gill's star positions, the uncertainty of the proper motions, and perhaps also in the low alti-

tude of these stars in the latitude of Helsingfors.

Some time ago I pointed out in the Astronomical Journal that the best method of investigating that portion of the optical distortion which depends on position angle would be to photograph the stars surrounding the pole several times, with widely different readings of the hour circle. In this way the quantity sought will not be dependent on star places or proper motions, and a very favorable distribution of the stars can easily be secured. Such a research can be made to furnish incidentally a very accurate catalogue of the stars surrounding the pole.

Through the courtesy of Dr. Gill and Professor Donner I have secured a collection of polar plates of the two poles specially made for the present purpose, and I propose to effect the measurement and reduction of these plates at Columbia College, using the Repsold photographic measuring machine recently presented to the College by Mr. Rutherfurd Stuyvesant. The plates are twelve in number for each pole, and are symmetrically distributed about the pole in the manner most favorable for the purpose in hand. It is to be noted also that the observatories of the Cape and Helsingfors are the most favorably situated respectively for the North and South Poles. We may therefore confidently expect considerable information on this difficult point, if the present research can be carried to a successful conclusion.

Other astro-photographic work going on under my immediate supervision includes the re-measurment of the old Rutherfurd plates of the Pleiades which were discussed in my paper on that group of stars. It is hoped that this re-measurement will show that the old plates have not deteriorated. If this be the case we can proceed at once to the measurement of a great number of Rutherfurd plates that have never been measured at all. The great importance of these plates arises from the fact that they have a thirty-year precedence of all other plates for the purpose of making a study of proper motions.

Dr. Davis has been working on the reduction of the plates measured by Rutherfurd and has carried several clusters almost to completion. These include the stars surrounding Mu Cassiopeiæ, 1830 Groombridge, 61 Cygni, and one or two others. All these are being computed in a manner similar to the process used in the case of the Pleiades. Dr. Davis also has in hand a study of the relative masses of the two components of the double star Eta Cassiopeiæ, from the Rutherfurd measures recently published by him. This work is being done according to formulæ which I presented at a recent meeting of the New York Academy of Sciences. Especial thanks are due to Prof. J. K. Rees, director of the observatory, who has done everything in his power to further the prosecution of the above researches.

Among other researches of importance which cannot be actively pushed at present, on account of insufficient assistance, I may mention the measurement and reduction of a series of plates of the stars used by Gill for comparison with the planet Victoria in his Solar Parallax work. These plates were made at the Cape Observatory about the time of the Victoria observations, and they have been placed in my hands by Dr. Gill for discussion. The plates are now at Columbia College. All the plates to which reference has been made in this notice, except Rutherfurd's, are provided with a 'Réseau,' or network of straight lines photographed on the plate. By the aid of this réseau it is certain that we can eliminate the effects of any distortion of the film during development. The measurement is also greatly facilitated by it. It is to be hoped that Columbia College will in time possess

an organized Bureau of Measures, where astro-photographic researches can be carried out for other astronomers who have not the facilities or the means of doing the work themselves. HAROLD JACOBY.

CURRENT NOTES ON ANTHROPOLOGY (XIII.)

ANCIENT METAL INDUSTRY IN THE CAUCASUS.

A VALUABLE monograph has lately appeared, by Professor Rudolph Virchow, in the Proceedings of the Prussian Academy of Sciences under the title, 'The Culture-Historical Position of the Caucasus, with special reference to the ornamented bronze girdles obtained from Trans-Caucasian graves.'

It appears that from the oldest burial sites in Trans-Caucasia specimens of metal-work are exhumed, remarkably beautiful in design and proving a highly developed technique. Careful studies have shown that this was not an indigenous industry. The artists had learned their trade elsewhere, or had immigrated from other lands. They were not in close relation with the contemporary art of Armenia; nor is the Assyrian or Babylonian influence especially pronounced, though at times visible. The art motives are unlike those which prevailed in Europe. Perhaps the connection should be sought with the prehistoric culture of Persia; but of this we have at present too few examples to speak of it positively. This much Dr. Virchow makes clear: That the Caucasian art was not developed *in situ*; that it was unexpectedly rich; that it is Oriental in inspiration; and that it points to some older center of culture not yet located.

ALLEGED WESTERN ORIGIN OF CHINESE CULTURE.

READERS acquainted with the voluminous writings of the late Terrien de La Couperie will recall the zeal with which he expounded and defended the theory that the origin of Chinese culture should be sought in Mesopotamia, among the Elamites of Susa. A number of them, he claimed, migrated eastward, carrying with them an advanced civilization, and appear in Chinese history as the 'Bak' tribes, those now referred to as the *Pe Sing*, 'the hundred-named.' He further explained that *Pe*, *Pek*, or *Bak*, was in origin a *nomen gentile*, non-Chinese in derivation, but assigned a meaning later in that language. These opinions he defended with much vigor.

They have, however, been completely demolished by M. de Harlez, in the October number of Schlegel's *Archives de L'Orient*. His exhaustive discussion of the etymology of *Pe Sing* leaves no doubt of the incorrectness of de La Couperie's assumption; and the theory of the extension of the Mesopotamian culture into China, as well as that of the imagined presence of the true Mongolian race in the Euphrates Valley in prehistoric times, are both rudely shaken. In a paper on 'The Proto-historic Ethnography of Western Asia,' which I published last spring in the Proceedings of the American Philosophical Society, I pointed out how frail was the foundation of both assumptions.

A NEW THEORY ABOUT THE MEDITERRANEAN RACE.

PROF. GIUSEPPE SERGI is well known for his extended anthropological studies, and especially for his novel craniological methods. Quite recently he has published a volume of 144 pages with a map and outlines of skull forms, to make known his conclusions on the origin of the Mediterranean race (Origine e Diffusione della Stirpe Mediterranea, Roma, 1895).

After clearing the ground of a number of opinions contrary to his own, he proceeds to demonstrate that the ancestors of the Egyptians, Aryans, Libyans, Pelasgians and Etruscans migrated from a 'center of diffusion' in Africa, near the headwaters

of the river Nile. He believes that he is able approximately to trace their early wanderings and to some extent their admixtures, by a comparison of skull forms. At this time, when there is so little unanimity among craniologists as to the value of their science in ethnography, it seems rather daring to select it as the corner stone of any hypothesis of ancient relationship; and it may be regarded as very doubtful whether Prof. Sergi will find many to accept his conclusions.

PREHISTORIC TREPHINING IN RUSSIA.

AN article by General von Krahmer in the *Globus*, Bd. LXVII., No. 11, describes an amulet obtained in 1883 from a neolithic burial in Russia. It was of bone, and on examination proved to have been taken from a human skull. Ten years later the archæologist Bieljachewski, in exploring a deposit on the banks of the Dnieper, exhumed a human skull from which just such a fragment must have been removed. Careful inspection showed that the trepanation had been performed after death, the spot selected being the right frontal bone. The instrument must have had a sharp cutting edge, but a lack of skill is manifested in the use of it. The skull belonged to a comparatively young person, probably a woman. From objects collected in its immediate vicinity, it may be assigned to the twelfth century.

Such examples are extremely rare in Russia. Among the crania at the anthropological museum in Moscow there is but one which shows ancient trepanation; but it is catalogued as from the Caucasus. However, the evidence brought forward by General von Krahmer, showing that this operation was occasionally practiced in order to obtain amulets from the parietes of the skull, is valuable as illustrating a primitive superstition which prevailed in several widely separated tribes.

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CURRENT NOTES ON PHYSIOGRAPHY (XIX.).

A LIMESTONE DESERT IN THE ALPS.

MUCH has been written about the barren and weathered limestone areas known as Lapiés, Lapiaz, or Karrenfelder, in the Alps. An interesting and well-illustrated account of the peculiar rock forms occurring on one of these areas, the 'Desert of of Platé,' in the Alps of Savoy, is lately presented by E. Chaix, of the Geneva cantonal school of horticulture (La topographie du desert de Platé, Le Globe, Genève, xxxiv, 1895, 67–108, excellent plates, map, 1:5,000). The desert occurs at an elevation of from 1,900 to 2,000 meters, an inextricable chaos of angular limestone ledges, a labyrinth of curiously sculptured rocks and deep worn crevasses. The surface chisellings are in the form of little troughs, varying in size in different strata, but always leading down the slope of the rock; these are ascribed to post-glacial wasting and washing. The crevasses, or open joints, are of older diastrophic origin but of modern weathering; they intersect successive strata, varying in width of opening as they pass from one bed to another, sometimes single and simple, sometimes very confused in their arrangement. A good review of previous writings on this subject is included in the essay.

MORAINIC AMPHITHEATER OF IVREA.

BESIDES the existing lakes enclosed by moraines at the Italian base of the Alps, there are certain extinct lakes—now alluvial plains—similarly enclosed; that of Ivrea, where the valley of the Dora Baltea opens from the mountains upon the great fluviatile plain, being the most remarkable. Agostini describes this great amphitheater in connection with its peat deposits (Le torbiere dell' Anfiteatro morenico d' Ivrea. Rev. geogr. ital., ii, 1895, 278–294, map). The best peat is found in the comparatively small basins that occur in the irregular

morainic wall; the small inwash of alluvium probably explaining the purity of these deposits. The great basin enclosed by the moraine is almost filled by the alluvium of the Dora Baltea, but at the extreme front of the amphitheater directly next to the inner slope of the moraine, and some distance on either side of the medial course of the river, two shallow lakes, Viverone and Candia, with marginal peat deposits, still remain. Other small basins, either lakes or peat bogs, occur on the alluvial plain and in shallow rock basins near the head of the amphitheater.

THE DEFORESTING OF MOUNTAINS.

A NATIONAL congress of French geographical societies was held last year at Lyons, and a report of its proceedings has been published by the geographical society of that city. To this volume Guénot, of Toulouse, contributed an essay on the effects of the deforesting of mountains, a subject to which he had previously given much attention. The Causses, plateau-like uplands in southern France, have for various reasons, historical and political, been gradually stripped of their forests, and as a result they are largely depopulated; twenty years has sufficed to transform a wooded district into a stony desert. In the Pyrenees the reports of the forestry officials show a constant relation between deforesting and various injurious effects, such as the stripping of soil from the slopes, the increased violence of floods in the mountain torrents and the decrease of population. In some valleys forest area and population have fallen to half their former numbers; in others the complete destruction of the forests has been followed by the complete abandonment of the district. Guénot urges a revision of the existing forestry laws in France, the extension of an organization known as the '*amis des arbres*,' and the introduction of tree-planting, as with us on Arbor Day. Confidence in the author is somewhat shaken by his exaggerated ideas about American matters; deforesting in this country is held responsible for severe droughts, for extreme heat and cold, and for heavy rains and floods; while our Arbor Day is described as a popular, national and religious fête, 'celebrated with the most astonishing solemnity.' W. M. DAVIS.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

WINTER MEETINGS OF THE SCIENTIFIC SOCIETIES.

The American Society of Naturalists and the affiliated and related societies will meet at the University of Pennsylvania, Philadelphia, on the days immediately following Christmas, December 26th, 27th and 28th. The Society of Naturalists will meet on the afternoon of the 26th to organize and to hear the address of the President. The meetings promise to be of unusual scientific interest, and all possible arrangements have been made to contribute to the social entertainment of the members. The officers of several societies are as follows: *The American Society of Naturalists*—President, Prof. E. D. Cope, University of Pennsylvania; Secretary, Prof. H. C. Bumpus, Brown University. *The American Morphological Society*—President, Prof. E. B. Wilson, Columbia College; Secretary, Dr. G. H. Parker, Harvard University. *The American Physiological Society*—President, Prof. H. P. Bowditch, Harvard University; Secretary, Prof. S. F. Lee, Columbia College. *The Geological Society of America*, President—Prof. N. S. Shaler, Harvard University; Secretary, Prof. H. L. Fairchild, University of Rochester. *The Association of American Anatomists*—President, Dr. Thomas Dwight, Harvard University; Secretary, Dr. D. S. Lamb, Washington. *The American Psychological Association*—President, Prof. J. McKeen Cattell, Columbia College; Secretary,

Prof. E. C. Sanford, Clark University. Programs of the meetings and other information can be obtained from the Secretaries.

FIELD WORK IN GEOLOGY AT THE UNIVERSITY OF KANSAS.

IN the spring of 1895 the Board of Regents of the University of Kansas formally opened the University Geological Survey of Kansas, a bureau which they were authorized to establish at their discretion, by the law making appropriation for the University in 1889, and repeated in every appropriation bill passed by the Kansas Legislature since that time. Active field work was begun in the summer of 1893 and has been prosecuted with increasing vigor each succeeding summer. In 1893 Prof. Haworth, of the department of physical geology and mineralogy in the University, had three men in the field. They succeeded in running geologic sections in various places in the southeastern part of the State, and published a brief account of the results in the Kansas University Quarterly, January, 1894. During the summer of 1894 he had five men in the field who continued investigations in stratigraphy in eastern Kansas. Some of the results of this season's work were given in the University Quarterly of April, 1895. During the summer of 1895 the work was greatly extended. The Legislature passed a bill creating a State Board of Irrigation, of which, it is provided, 'the professor of geology in the University' should be a member. This added greatly to the opportunities of the University, as additional funds were available for expenses. A total of twelve men, besides Prof. Haworth, were engaged for longer or shorter periods during the summer, five of whom were working with special reference to the water problems in the western part of the State, two others in the Cretaceous doing stratigraphic and areal work, one devoting his time exclusively to the salt deposits of the State, one to a detailed study of the coal mines and mining, one to a study of glacial phenomena in northeastern Kansas, and others to general stratigraphic work in the Carboniferous.

As a result of these various operations a volume on the stratigraphy of the Carboniferous is now ready for publication. A preliminary report on the water supply of the western part of the State will be completed by the last of December, and large quantities of material have been gathered for succeeding volumes on the stratigraphy of the Cretaceous and Tertiary of the State, on the economic geology of the State, etc. The question of publication is not yet definitely settled, as the Legislative enactment made no special provision for it; but it is hoped that in one way or another the work of the organized survey will not be seriously hindered by a lack of means for publication.

THE BIOLOGICAL EXPERIMENT STATION OF THE UNIVERSITY OF ILLINOIS.

THOUGH established with the primary aim of affording opportunity for research for its own staff, the Station will in future be open during the months of June, July and August to biological investigators and to students of some experience in zoölogical or botanical work.

The Station is established on the Illinois River, with principal headquarters at the county town of Havana, forty miles below Peoria and a hundred miles west of the University of Illinois. It has for its field of operations the banks and waters of the Illinois River itself and a selected series of lakes, streams and bayous of the vicinity, presenting an extraordinary variety of situations, rich beyond any ordinary experience in number and variety of plant and animal forms. The collecting stations are all within convenient access from the town, at outside distances of a mile to the south and three miles to the north.

Those whose experience has been confined to the seashore or to our inland lakes, large or small, can have but little conception of the abunbance of biological material accessible, with the minimum of effort and expense, to the student at the Illinois Station.

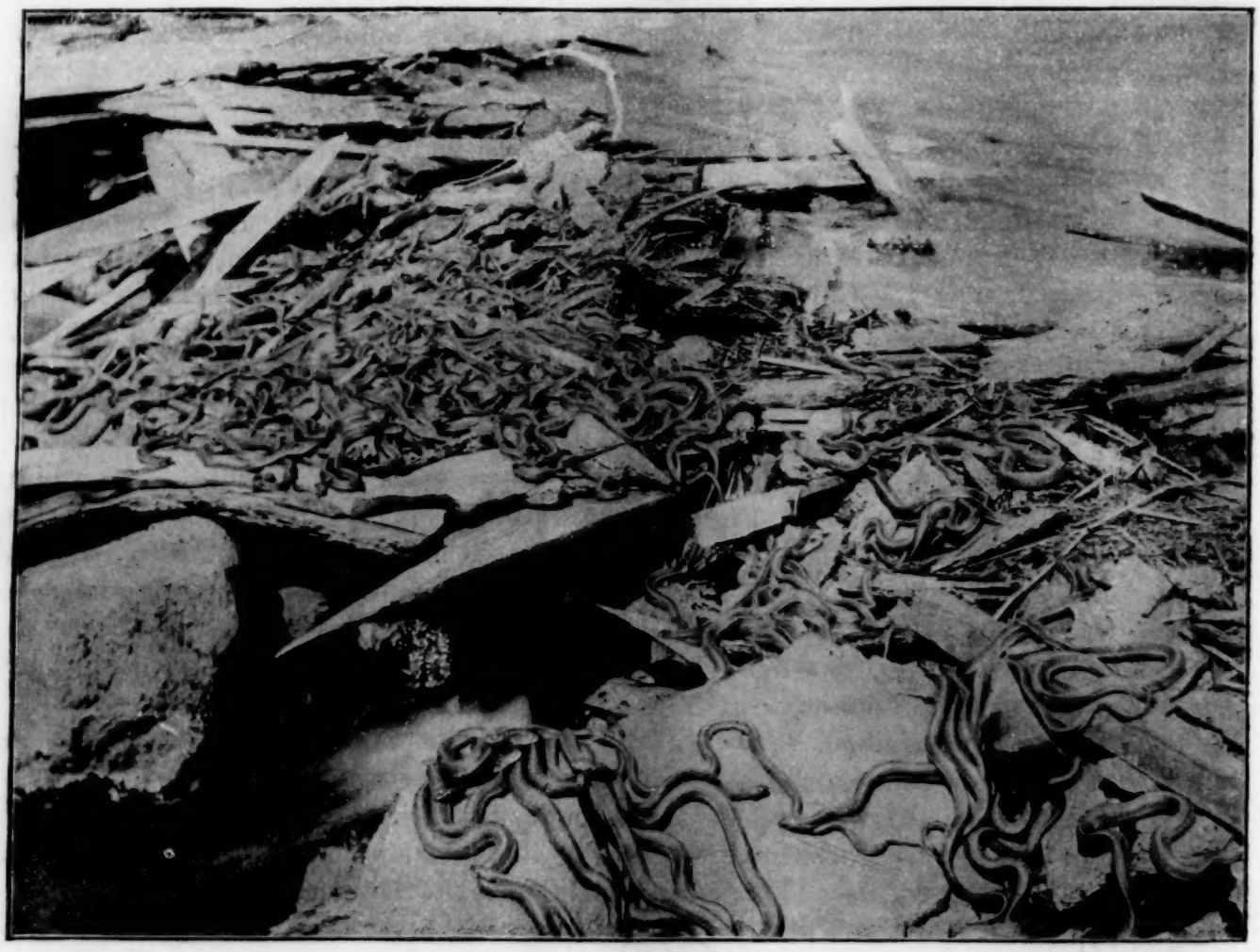
The laboratory is fully equipped with all necessary appliances. The present accommodations are sufficient for sixteen persons.

Applications for admissson must be made in advance and at as early a day as practicable, with precise specification of the period for which the applicant wishes to occupy a table in the Station laboratory. All further particulars may be obtained from the director, Prof. S. A. Forbes, Urbana, Ill.

SNAKES IN OREGON.

In the vicinity of Klamath River, Klamath county, Oregon, a certain species of *Eutænia* swarms by scores, by the hundreds and by the thousands. They are found mostly along the water courses in the grass or sunning themselves on the bare rocks or driftwood in the streams or on their banks.

The accompanying illustration is from a



photograph made on a branch of the Klamath River, three miles south of Klamath Falls, Oregon. It was obtained in the latter part of July last and kindly furnished us by Mr. James A. Diggles, a student of geology at Stanford University. The negative was made about ten o'clock in the morning. Such a display is by no means

an exceptional one along this stream; indeed this photograph was made only a few paces above the public road which crosses the stream a little to the left of the view. The snakes are harmless. Mr. Diggles says that there is a species of water frog quite as abundant in that region as the snakes, and that the snakes are said to feed on the frogs.

GENERAL.

AT the recent meeting of the French Association for the Advancement of Science at Bordeaux a committee composed of M. Boudouin, director of the International Institute of Scientific Bibliography; M. R. Blanchard, general secretary of the Zoölogical Society of France; M. Cartaz, assistant secretary of the Council of the French Association; M. Gabriel, secretary of the Council of the Association, and M. Ch. Richet, editor of the *Revue Scientifique* and professor of physiology in the Medical School of Paris, presented a report on the titles that should be given to scientific articles in order to make their bibliographic classification easier. The report was discussed at a special session of the Association and two recommendations were adopted: That titles should be made as brief and exact as possible and that the word characterizing the subject treated should be italicized. In case subdivisions of a subject are treated, these should be indicated by words in the title, the first half of which words should be italicized. The recent International Biographical Conference approved this plan, and it will be adopted by several journals, including the *Revue Scientifique*.

A BRIGHT comet was discovered during last week at Lick Observatory, in right asconsion 13 deg. 44 min., north declination 1 deg. 40 min., in the constellation of Virgo. The comet has a short tail and a stellar nucleus of about the seventh magnitude.

DR. F. P. PORCHER, a well-known physician and botanist, died at Charleston, S. C., on November 19th, at the age of seventy. He was professor of materia medica and therapeutics in the Medical College of the State of South Carolina and was the author of numerous works on pharmaceutical botany.

CARL STECKELMAN, known for his explorations in South Africa, was drowned on August 28th.

DURING the summer vacation Prof. G. C. Comstock, director of the Washburn Observatory and professor of astronomy in the University of Wisconsin, coöperated with the authorites of the University of Minnesota in determining the longitude of their new observatory by an exchange of telegraphic time signals between Madison and Minneapolis. Mr. A. S. Flint, assistant astronomer in the University, recently presented to the American Association for the Advancement of Science the partial results of an extensive series of observations made at the Washburn Observatory for determining the distances of the nearer fixed stars. This work is now approaching its completion and will be the most comprehensive series of determinations of stellar distance ever made.

PROF. GEORGE M. DAWSON, director of the Geological Survey of Canada, who died recently at Halifax, Nova Scotia, was the son of Sir J. William Dawson, and was born at Pictou, Nova Scotia, on August 1, 1849. The *London Standard* states that he was appointed Geologist and Naturalist to her Majesty's North American Boundary Commission in 1873, and in 1875 he published a detailed report on the country traversed from the Lake of the Woods to the Rocky Mountains, entitled 'Geology and Resources of the 49th Parallel.' He was appointed to the Geological Survey of Canada in 1875, and had since been principally engaged in the survey and exploration of the Northwest Territory and Brit-

ish Columbia, and was placed in charge of the Yukon expedition, undertaken by the Canadian government in 1887. As one of her Majesty's Behring Sea Commissioners he spent the summer of 1891 in investigating the facts connected with the fur-seal fishery on the northern coasts of America and Asia. Two years later he was elected president of the Royal Society of Canada. In January, 1895, he was appointed director of the Geological Survey of Canada. He was the author of numerous original scientific papers, principally geological, but including geographical, ethnological and other observations made in the course of his explorations.

Mr. Edward Philip Loftus Brock, honorary secretary of the British Archæological Association, died in London on November 2d.

Mr. Bernard Grenfell, fellow of Queens College, Oxford, intends shortly to visit Egypt to continue his studies on Greek papyri.

The *Boston Transcript* states that Prof. David P. Todd will undertake the direction of an expedition to be sent out from Amherst College for the purpose of observing the solar eclipse of 1896. The expedition will sail from San Francisco next spring, on the schooner yacht Coronet, which will be in command of Captain Arthur C. James, New York Yacht Club, a member of the class of '89. The island of Yezo, one of the largest northern islands of the Japanese Empire, has been chosen as the point of observation.

The Pharmaceutical Society of Great Britain has presented the Hanbury Medal to Dr. August Vogl. This is the eighth award of this medal, which was presented in 1881 to Flückiger, in 1883 to John Elliot Howard, in 1885 to Dragendorff, in 1887 to Dymok, in 1889 to Plaichon, in 1891 to Hesse and in 1893 to Maish.

At a meeting of the Royal Institution on November 4th it was reported that the late Mr. John Bell Sedgwick, M.R.I., had bequeathed £300 to the Royal Institution in aid of the fund for the promotion of experimental research at low temperatures. The special thanks of the members were returned to Sir Frederick Abel for his donation of £50 to the same fund.

Dr. Fraser Harris proposed exhibiting before the Glasgow Philosophical Society a new optical instrument known as the stereo-photo-chromoscope, the aim of which is to photograph an object in such a way that the 'positive' of the picture, viewed as a transparency, will present the object with its natural colors and also with stereoscopic effects.

The *Revue Scientifique* states that M. G. Delage will issue at the beginning of next year an *Année biologique*, which will give analytical and critical reviews of publications in general biology.

A course of Monday evening lectures has been instituted by the faculty of the University of the City of New York, who will lecture on their respective subjects to the people living in the vicinity of University Heights. The first lecture was delivered by Dr. J. J. Stevenson, in the lecture room of the Havemeyer Laboratory, on 'Coal.'

UNIVERSITY AND EDUCATIONAL NEWS.

Prof. William M. Thornton, chairman of the faculty of the University of Virginia, has published a letter stating the needs and plans of the University. Reconstruction of the Rotunda, the central building of the group recently destroyed, has already been begun. It will be restored in its original form, a reproduction on the half scale of the Roman Pantheon, but with fire-proof materials. The necessary money for this purpose, about $80,000, has been practically subscribed.

In place of the large rectangular annex to the Rotunda, built in 1852 for the accomodation of the growing classes of the University, a number of isolated structures will be erected. They are to be a general academical building costing $90,000, a physical laboratory costing $30,000, a building for mechanics and engineering costing $30,000, and a building for the law school costing $20,000. Governor O'Ferrall has promised to recommend in his message to the State Legislature a prompt and liberal appropriation to repair the losses of the school, and it is hoped that $200,000 will be received from this source. Friends of the University and of Education are urged to contribute liberally to the rebuilding and enlargement of the University.

DAVID J. HILL, President of the University of Rochester, has resigned. The action is said to be on account of the opposition to him manifested by conservative Baptists who have not favored his liberal views and management of the University.

AT its last biennial session the Legislature of Minnesota appropriated $10,000 for the erection of a Students' Observatory at the University of Minnesota. The building is already under roof and is promised for use by the first of January. The equipment will include a ten-inch equatorial of 150 inches focal length. This instrument is to have three objectives, one combination of which forms the visual telescopic objective and another the photographic objective. There are also three eye pieces of different magnifying powers, a filar micrometer and a driving clock. Two reading microscopes are provided for reading the declination circles, and the guiding telescope is of four-inch aperture. A spectroscope and photograph measuring machine are among the instruments soon to be added Upon the completion of this working observatory Prof. Leavenworth will offer courses in astronomy in advance of those which are now in the curriculum of the institution.

DR. H. P. JOHNSON, Harvard '90, Chicago '94, succeeds Mr. J. J. Rivers as Curator of the Museum of the University of California. Dr. J. C. Merriam, Munich '93, has been appointed instructor in paleontology.

PROF. JEROME H. RAYMOND, formerly of the University of Chicago, has been appointed professor of sociology and secretary of the University Extension Department of the University of Wisconsin.

THE will of Rev. John H. Duggan of Waterbury, Conn., leaves his library to the Catholic University of America at Washington, D. C.

DR. FREDERICK H. WINES has been appointed lecturer on social classes and social evils in Harvard University.

THE Agassiz professorship of Oriental languages at the University of California has been filled by the election of Dr. John Fryer, who has been for many years and is now a translator in the service of the Emperor of China. Dr. Fryer assumes his new duties the latter part of the present term or early in the next.

DR. HARRY MARSHALL WARD, Sc.D., F. R.S., of Christ's College, professor of botany at the Indian Engineering College, Cooper's-hill, has been elected to the chair of botany in the University of Cambridge, vacated through the death of Prof. Babington. The following particulars concerning Dr. Ward's work in botany are taken from the *London Times*:

Dr. Ward graduated B.A. as a member of Christ's College, obtaining a first-class in the Natural Sciences Tripos, 1879, with distinction in botany. In 1883 he was elected to a Fellowship, and in 1888 was elected a Fellow of the Royal Society. After taking his degree at Cambridge he devoted himself with ardour and success

to research. He, at the invitation of the Ceylon government, investigated the disease which about the year 1880 devastated the coffee plantations of Ceylon. His account of the life-history of *Hemilieia vastatrix*, the fungus which immediately caused the disease, while contributing many new morphological and physiological facts, was especially valuable by reason of the scientific basis it established by which the method of the treatment of the disease that might be adopted should be founded. In 1889 he contributed a paper to the Royal Society 'On the tubercles in the roots of leguminous plants, with special reference to the pea and the bean.' In the following year, 1890, he was selected to deliver the Croomian lecture before the Royal Society, and selected as his subject 'The Relations between Host and Parasite in certain Epidemic Diseases of Plants.' In 1891 his paper on 'The Ginger-beer Plant and the Organisms composing it, a Contribution to the Study of Fermentation Yeasts and Bacteria,' attracted much attention, and was described by Lord Kelvin as a model of experimental biological investigation. In 1892 he contributed an important paper, entitled 'Experiments on the Action of Light on Bacillus Anthracis.' A further paper on the same subject was written by him, and later, in conjunction with Mr. P. F. Frankland, he contributed to the second report of the Water Research Committee of the Royal Society a paper entitled 'The Vitality and Virulence of Bacillus Antracis and its Spores in Potable Water.' In 1893 the Royal Society recognized his great merit as an investigator by awarding him a Royal medal, and the President of the Society (Lord Kelvin) especially alluded to Prof. Ward's contribution on the action of light in arresting the development of and killing bacteria as having brought out striking results, the significance of which, from a sanitary point of view, was sufficiently apparent, and, further, had led to other investigations by Prof. Ward into the wide question of the function of color in the vegetable kingdom. These further investigations were communicated to the Society in 1894 and form a part of the third report of the Water Research Committee. It may be mentioned that the value of the professorship is £700 a year, and it is tenable for life, subject to certain regulations as to residence and delivery of courses of lectures.

At the meeting of the University Court of Glasgow University, according to *The Lancet*, a letter was received from Mr. C. W. Mitchell, who quotes from a letter to Sir W. Geddes, written by the late Dr. Mitchell, who said: "Lord Huntly, I believe, is endeavoring to raise a special fund of £20,000, and if £6000 of that amount can be collected soon I would be prepared to contribute an additional £4000; further, if his lordship can increase his collection in £10,000 I will increase my subscription to £6000, thus making up the required £16,000 without appeal to the Government." "I now beg to confirm this offer," writes Mr. Mitchell, "subject to the consideration that your lordship's£6000 is collected by January 1, 1896, and the additional $4000 by May 1st."

Mr. James Wilson, lecturer in agriculture at the University College of Wales, has been appointed to a similar lectureship in Glasgow University.

Dr. Ostmann, of Königsberg, has been appointed extraordinary professor of otology in succession to Professor Barth, who goes to Breslau.

DISCUSSION AND CORRESPONDENCE.

EXPERIMENTAL PSYCHOLOGY IN AMERICA.

To the Editor of Science: I think my Journal, where the misunderstood words appeared, and where their context could be seen, should have had a chance to print the well concerted

quartet of letters in your issue of November 8. I see no ground for invoking the larger public of SCIENCE. Accepting, however, the change of *venue*, permit me to say, first, I never dreamed of disparaging a rival journal, or of implying in the remotest way either that mine was or even that the *Review* was not an *Archiv*. The reference was solely to the twice-considered plan of dropping all reviews, notes, etc., from the Journal and printing only researches as long, perhaps, as those lately printed separately by Profs. Cattell, Fullerton, Nichols, Brandt, etc.

Still less, if possible, did I dream of making or implying any claim so preposterous as that I or the Journal had 'accomplished nearly everything' 'for the advancement of psychology in America.' In the development of a new academic 'department' a crucial point is, as I deem it, when an instructor is appointed whose central work and interest is in that line. Such a point, I think, was marked both at the University of Pennsylvania and at Columbia by Prof. Cattell's appointment; at Wisconsin by Prof. Jastrow's; at Toronto by Dr. Kirschmann's; at Harvard by Dr. Nichols'; at Yale by Dr. Scripture's, and long ago at Johns Hopkins by my own. This, and this alone, was my theme. Had it been of the pioneer work, no less crucial, which made these appointments possible, which was done by Profs. James, Ladd, and earlier by President McCosh and others, I should not only have desired to say nearly all they have said, but more. To Prof. James, especially, I owe a debt I can never repay, unless by trying to influence him to correct the views in which we more and more widely differ, some of which he will bear me witness I have earnestly tried to do.

I am very sorry the name of Toronto got on the list of laboratories affected by our work. It is a mistake I cannot account for, and I am glad to correct the error with due apologies to all aggrieved thereby. The difference too between the wording of the relation between the assistant editors and myself, Dr. Sanford desires me to state, was his regrettable mistake, and will be corrected, according to the original announcement, in the next number.

As to the comparative influence of Yale and Clark upon men who have attended both, I prefer to yield all claims rather than divide the child; so I do as to Dr. Scripture, and also as to the size of my 'influence' at Princeton. As Socrates said of the disputations of the sophist Euthydemus, I would rather be refuted by such arguments than to use them.

For one, I sincerely hope that in this transition period the psychological atmosphere will not become too tense for a spirit of hearty coöperation, or too lax for healthful or virile competition.

G. STANLEY HALL.

CLARK UNIVERSITY, November 18, 1895.

THE BREHM CUTS AGAIN.

TO THE EDITOR OF SCIENCE: Referring to SCIENCE of April 5, 1895, p. 387, and June 21, p. 682, I beg to say that my original charge of libel against Dr. C. H. Merriam, for using the term 'piracy' in connection with the appearance of the Brehm cuts in the *Standard Natural History*, is not in the least affected by what appears in SCIENCE of October 25, 1895, p. 648. I believe the latter to be substantially correct; but it relates to an entirely different matter, viz.: action brought to recover damages for alleged breach of contract concerning resale of Brehm cuts and their subsequent use in other connections than the *Standard Natural History*. The case will be found fully and no doubt fairly stated in the Publishers' Weekly of October 26, 1895, p. 716; but it is one that I never raised, and know nothing about—only that it has nothing to do with the point I made; and I should not now bring it up again, except to correct a very possible misapprehension on the part of some who may be misled into the belief that my original charge does not remain in full force.

ELLIOTT COUES.

WASHINGTON, D. C., November 17, 1895.

QUATERNIONS.

EDITOR OF SCIENCE:—The communication in a recent issue of SCIENCE in reference to the formation of an International Society for the purpose of advancing the study of Quaternions is one of great significance to the friends of the subject in this country. The time is certainly fitting for the organization of such a society and

the suggestion should meet with a generous response. The project already has the support of Profs. Tait and Laisant and will, no doubt, be aided by the leading advocates of Quaternions everywhere. The movement should be encouraged in every possible way.

VICTOR C. ALDERSON.
ARMOUR INSTITUTE OF TECHNOLOGY, CHICAGO.

SCIENTIFIC LITERATURE.

The Forces of Nature. By HARROP and WALLIS. Published by the same, Columbus, Ohio. Pp. 160, 12 mo.

The reading of this book gives rise to a feeling of wonder; wonder that it was ever written; wonder that it was ever published and wonder that it should ever be read. About half of it is included in five chapters on 'The Solar System;' 'The Atmosphere—Sound;' 'Chemistry—The Structure of Matter; 'Radiant Energy—Light, Heat and Actinism;' 'Electricity—Magnetism.' These are large subjects, but the authors of this book do not shrink from the task, self-imposed, let us hope, of treating them in about seventy pages of large type and fair leading. Their aim has been, as stated in the introduction, to present 'the great fundamental principles of the Earth's science and the laws which govern the operations of Nature.' The importance of this presentation is forcibly shown in the following paragraph from the preface of this book: "All natural phenomena are explainable upon the simple laws of mechanics. These laws govern alike the systematic motions of worlds and the complicated functions of organic life. It only remains, then, for the reader to make himself conversant with the fundamental principles upon which the system hinges to comprehend the harmony of all things in nature." The preface further recognizes 'a class of persons who have acquired a thorough knowledge of their special callings' who unquestionably hunger after a knowledge of these fundamental principles and who desire to satisfy their ravenous appetites 'without tedious delving amongst learned volumes which they have probably neither the time nor the inclination to read.' For these the authors have written this book. It is not worth while to consume time and space in giving extensive references to its contents. Nine of its pages suffice for the consideration of the solar system, including a special study of the Earth. In the chapter on chemistry one or two great fundamental principles are let loose, including the statement that ice continues to expand as its temperature is lowered, and it is on account of this expansion that water pipes are burst. In the chapter on Radiant Energy we are distinctly, almost defiantly, informed that "Polarized light has some application in Optics and Qualitative Analysis," and also that when air is compressed "the molecules are moved into such close proximity as to be unable to retain all their former motion—heat—a portion of which is delivered up to external objects either by conduction or radiation." In accordance with the plan outlined in the introduction, having in the first seventy pages disposed of the 'general aspects of nature,' the remainder of the book is devoted to a 'more particular exposition of underlying principles' as put forth in 'a series of disconnected paragraphs and essays.' Here the authors toy with 'Life on the Planet Mars;' 'Spontaneous Generation;' 'The Incandescent Lamp;' 'Argon,' etc., etc., etc., forming almost as great a variety as the contents of a modern Sunday newspaper.

In their introduction they remark that 'the necessity for *consecutive* reading' cannot be too strongly urged; the common tendency to 'skip' is deplored and the reader is urged 'to proceed slowly, being sure that he understands each paragraph before leaving it.' That interesting class for whom the book is intended, 'persons who have acquired a thorough knowledge of their special callings,' will doubtless be able to understand the, to others rather obscure, relation between 'Life on the Planet Mars' and 'Death by Lightning,' which makes a certain order of reading necessary. To the ordinary reader of the Astronomical news of the past year or two, the latter might be chosen first, last and all the time.

A really serious aspect of this case is the announcement that the authors have in press a second volume on 'The Forces of Life,' which is to be 'a study of Organic Nature,' and which is to discuss the Classification of Species, Evolution, Paleontology, Morphology, Embryology, the origin of cell life, etc. If these youthful

Encyclopædists (it is difficult to imagine them to be anything else than youthful, no matter how many years they may have lived), will hold themselves in check until they learn something that other people do not know, or until they learn what other people do know so well and so clearly that they can claim some right to classify, edit and arrange existing knowledge, they will *confer a favor upon themselves* the magnitude of which it is difficult to estimate.

Alternating Electric Currents. By EDWIN J. HOUSTON and A. S. KENNELLY. New York, The W. J. Johnston Co. Pp. 225. Price $1.

This little volume forms one of the "Electro-Technical Series," of which nearly a dozen volumes have been prepared by Messrs. Houston and Kennelly. It treats of one of the most important and most prominent departments of applied electricity. The development of the theory of Alternating Currents and their practical utilization is of comparatively recent date. The large pecuniary interests involved in the various processes by which energy is transformed have put a premium upon the exploration and exploitation of this branch of physical science such as no other has ever felt. Workers in science generally are sustained by that motive and inspiration which compels the practical geographer to force his way into and through unknown regions, his reward being the knowledge of their nature and inhabitants, with which he is laden when he returns. In electricity there is the additional powerful incentive that gems and precious metals are tolerably sure to be met with. The science of electricity has prospered, therefore, during the last decade in a manner only equaled or excelled by its practical applications. Even the expert now finds it difficult to keep thoroughly informed of the rapid and often far-reaching advances that are continually being made. To the layman, or even to the general physicist, who has not been forced as, alas! nearly all have, to 'specialize' in electricity, any book which summarizes this progress in an intelligent and scientifically correct manner will be welcome. To such this book will be of much use. The conception of the alternating current is well worked out in the first chapter, and in those following its application to the transmission of power and to electric lighting is discussed in a popular readable form, including a discussion of diphase, triphase and monocyclic currents and transmission. The principle criticism that may be applied to the book is the unnecessary presentation of a great deal of elementary matter, concerning which the reader is almost sure to be already well informed. It does not seem likely that any one who undertakes to read a book, be it ever so simple, on 'Alternating Electric Currents' will be entirely ignorant of a simple primary battery, of the form of an electric magnet, of the appearance and construction of an incandescent lamp, of which there is a long and elaborate description. The amount of ignorance which is here assumed is not quite in harmony with the amount of technical information which the reader must possess in order to understand other portions of the book. The volume could have been made more valuable by assuming on the part of the reader that knowledge of direct current electricity which he is tolerably certain to possess or which he can readily obtain from other volumes of the same series. There are certain advantages, it is true, in having each volume complete in itself, but these are greatly exceeded by the disadvantages growing out of the enforced buying, owning and reading the same matter over and over again.

THE MAGNETIC RESURVEY OF AUSTRIA AND HUNGARY.

FROM a recent report* by Dr. Liznar, of the 'Central Anstalt für Meteorologie und Erdmagnetismus' of Vienna, we find that the recent magnetic resurvey of Austria and Hungary (1889–'93) has been brought to a termination. An earlier magnetic survey had already been made by Karl Kreil between the years 1843 and 1858, which was repeated a few years later,

*J. Liznar: Die Vertheilung der erdmagnetischen Kraft in Österreich-Ungarn zur Epoche 1890.0 nach den in den Yahren 1889 bis 1894 ausgeführten Messungen. 1 Theil, Erdmagnetische Messungen in Österreich ausgeführt auf Kosten d. Kais. Akad. d. Wiss. in d. Y. 1889–'93, von. J. Liznar. Wien, 1895, 4°, 232 pp. Repr. Denk. d. Wiener Akad. Math. naturw. Cl. Bd. LXII.

as far as Hungary was concerned, by Guido Schenzl. On account of the slow, so-called *secular changes*, whereby the distribution of terrestrial magnetism is forever changing its present aspect, it becomes essential to repeat such surveys from time to time. We are thus enabled to follow empirically, at least, the modus operandi of that occult, elusive force—the cause of the secular variation of terrestrial magnetism.

Other reasons make it desirable to repeat and amplify former surveys. Not only are our present methods of observations more refined, but experience has repeatedly taught that a magnetic chart based upon a few isolated observations gives but a very crude picture of the actual distribution of magnetism within the earth's crust. The complexity of the picture or the irregularity of the representative distribution curves furnishes, generally speaking, the truest index of the thoroughness of the underlying survey.

The first part of the report before us, of which the second is to appear later, is devoted to the publication and reduction of the observations made in Austria by Dr. Liznar, under the auspices of the Vienna Academy of Sciences. On pp. 230 and 231 is given in alphabetical order the 109 observation stations, together with their geographical positions and the observed magnetic elements reduced to the epoch 1890.0. The intensities (horizontal and total) are given to four decimals in mm. mg. s. units—a simple division by 10 will reduce to c. g. s. units.

The discussion of the results and the delineation by charts of the magnetic distribution are reserved for the second part, which is also to contain the observations made by previous agreement during the same time interval along the Adriatic coast by the Hydrographic office of Pola, and in Hungary by the Central Meteorological and Magnetic Institute of Budapest. Great care was taken that observations thus made under different auspices should be strictly comparable. Frequent inter-comparisions of the instruments used were made by selecting common observing stations, as also were the instruments compared with those at the Central Institute.

Two points are suggested by this report, the first of which may perhaps appear trivial, but from which we, nevertheless, might draw a useful lesson. This report, like many others of a scientific character, received from abroad is above all *well printed*, a fact which is not characteristic of some of our scientific government publications, whose typographical execution in several notable instances has been abominable. We believe that what is worth doing at all is not alone worth doing well, but also *printing well*. Too often the character of the contents is judged by the external appearance.

The second point suggested is the great desirability of a detailed magnetic survey of our own confines. Our Coast and Geodetic Survey is doing excellent work in this direction, but the comparatively few observations, if you consider the territorial extent involved, it can make with all its manifold other duties, are wholly inadequate for a fairly accurate representation of terrestrial magnetic distribution in the United States. How fraught with problems of the most interesting and suggestive character a *detailed* magnetic survey can present to the physicist and to the geologist has been clearly shown by the Rücker and Thorpe minute magnetic survey of Great Britain.

At the present time when many of the European governments have either just carried out detailed surveys or are about to do so, it behooves us to fall in line. But *one* State of the Union has received the distinction of having a fairly complete magnetic survey made of it, and this was due to the *private* enterprise and enthusiasm of Prof. Francis E. Nipher, of Washington University, St. Louis. Good work has also been accomplished in this direction by the geologists in New York, New Jersey and Pennsylvania. It is firmly believed that more of such detail work will redound to the benefit of geology and of geomagnetism.

L. A. B.

Tables for the Determination of Common Minerals. By Prof. W. O. Crosby, of the Mass. Inst. of Technology.

This book, the third edition of which has just been published (1895), is a very carefully prepared scheme for the determination of about two hundred and twenty-five of the more com-

mon mineral species, chiefly by means of their physical properties with confirmatory chemical tests. A special feature is the addition of a supplemental table for the determination of one hundred of the rarer minerals, thus avoiding for the student the unnecessary use of a large cumbersome scheme, and at the same time reducing to a minimum the chances of meeting a mineral not contained in the Tables.

The general idea of the scheme is to make two grand divisions into the minerals *with* and the minerals *without metallic lustre*. The minerals having *metallic lustre* being further sub-divided into groups by their *color* and approximate *hardness*. The minerals with *non-metallic lustre* being grouped by color of *streak*, approximate *hardness*, *specific gravity* and general structure.

These Tables carry out the idea that a scheme is the *better*, the more closely it tends to facilitate recognition of minerals at sight by their structural and physical characters. For this reason chemical tests are only used as confirmatory and are made as simple as possible, so as to put them within the reach of persons having only a blowpipe outfit. Schemes of this character can be used with great success by students who are more or less proficient in mineralogy, and who have been carefully trained in observation. One part of the scheme that might give trouble to beginners is the required determination of the specific gravity of the non-metallic minerals. A determination for which special apparatus is needed and which is generally more or less difficult. Schemes for the non-metallic minerals based on fusibility and solubility, especially when dealing with massive minerals, may give more general satisfaction when used by beginners.

The introductory part includes a detailed description of the morphological, physical and chemical properties of minerals, and a short explanation of the blowpipe tests made use of in the Tables. A simple and inexpensive form of specific gravity apparatus is also described. A list is furnished the student of fifty of the common minerals, giving very characteristic tests and most useful in commencing a course of determinative mineralogy.

A very convenient chapter is that on 'How to use the Tables.' Here the structural, physical and chemical properties of several minerals are given, and the student is taken, step by step, by reference to page, etc., through the actual determination or confirmation of the mineral. A great advantage in this scheme is having the general synopsis all contained on one page, after reference to which it is generally possible to turn immediately to the part of the Tables needed for the determination of the special mineral in question.

The separation of the scale of hardness into five divisions instead of ten also has its advantages, as it makes possible the use of the Tables when only an approximate determination of the hardness has been made.

After each mineral species in the Tables a number, in parenthesis, is given, which refers to the synopsis of classification where at a glance the general relation of the special mineral to the rest of the mineral kingdom is given.

At the end of the Tables a very convenient index of mineral names and synonyms is found.

LEA MCI. LUQUER.

Fauna fosil de la Sierra de Catorce, en San Luis Potosi. AGUILERA Y DEL CASTILLO. Boletin de la Comision Geologica de Mexico. No. 1, Mexico. 1895. Pp. 55, plates xxiv.

In this publication, the authors confirm the existence of the Jurassic System in Mexico. They note that the formation has a vast extent, greater than is commonly believed, partly for the reason that the localities are widely separated and difficult of access. The fossils also are scarce and not well preserved. Another circumstance which appears to be unfavorable to the recognition of the system is its gradual passage into the overlying Cretaceous. This transition zone is barren of fossils or at best contains forms which are of difficult interpretation. The Jurassic rocks belong mostly to the upper division, but localities exist in which strata are found representing the middle and lower members. Some authors, deceived by the resemblance of the Cretaceous limestones to those of the Jura, have referred these deposits to the Jurassic, but our authors have referred them on the evidence of their contained fossils to the Cretaceous on the geological map of the Republic.

The Jurassic fauna consists largely of species apparently peculiar to Mexico. It is characterized by numerous forms of Aucella and Perisphinctes, about half of which are described as new species. This paper, following so soon after the discoveries of Diller and Hyatt in California, is of much interest to American geologists.

The authors have been unfortunate in the hands of their lithographer. The plates are of little use; some of the figures are scarcely recognizable.

J. B. Woodworth.

An Introduction to General Biology. Sedgwick and Wilson. Second Edition. 1895. New York, Henry Holt & Co.

The original Practical Biology of Huxley and Martin, written in 1875, has stimulated the production of a large growth of text-books and laboratory manuals. Huxley and Martin attempted to present the fundamental facts of biology to the student by the study of a series of typical animals and plants, beginning with the simplest and ending with the more complex. Nevertheless, this logical method proved impractical and in a later and too-much enlarged edition the authors (or rather their successors, with Huxley's approval) reversed the order of treatment of the subject. The higher forms were first studied and then the student was led down through a series of simpler forms. Huxley said, however admirable the first method followed by him had been 'it had its defects in practice.'

Sedgwick and Wilson adopted, in 1886, a third order of procedure in the first edition of their General Biology. Two common forms, the fern and the earthworm, were first thoroughly described as introductory to a later study of other animals and plants; and a second volume was promised, dealing with the other forms. This second part has never appeared and its publication has been finally abandoned.

A *second edition* of the General Biology of Sedgwick and Wilson has just come out and will be welcomed by all those who have learned through experience the great value of the first edition.

In the present edition the principal changes are as follows: (1) The book has been enlarged so as to include a series of unicellular forms (Amœba, Infusoria, Protococcus, Yeasts, Bacteria). (2) The laboratory directions given in the first edition have been omitted. In their place an admirable appendix has been added. The appendix describes the best methods in preserving and preparing the forms described in the text; a large number of valuable and practical suggestions are also added. (3) The order of presentation has been reversed. The earthworm now comes first and then the fern follows.

In the first edition, and in the present edition also, the student is introduced to the subject of General Biology by a chapter dealing with the differences between living and lifeless things, 'believing that Biology should follow the example of Physics and Chemistry in discussing at the outset the fundamental properties of matter and energy.' If we consider, however, the unsettled state of mind of biologists at present on these fundamental questions and, further, the presumed ignorance of the student of all knowledge of living things we cannot but think this method of presentation open to question.

The next two chapters in the present edition, following the order of the first edition, deal with a study of a series of heterogeneous objects illustrating 'the structure of living things' and 'protoplasm and the cell.' The *pièce de resistance* is then introduced.

The reason assigned by the authors for offering first the earthworm 'lies in the greater ease with which the physiology of an animal can be approached.' However true this may be from the student's standpoint, it presents certain difficulties to the concientious teacher, for in reality very little physiology is actually known for the earthworm, 'save by analogy with higher animals.'

For ourselves, we prefer *at present* the old sequence with the plant first and the animal later, admitting wide scope for individual taste. Practically, we have found that the new edition adapts itself to our own idiosyncrasies and works backward just as well as forward.

Most important additions and corrections have been made to the description of the structure of the earthworm. The accounts of the circulatory and nephrideal systems have been

extended. The former imperfect description of the male reproductive organs has been corrected. The histology of the nervous system is more fully described and the results brought up to date according to Retzius and Lenhossék.

The description of the development of the earthworm from the egg is more fully given, and a description of the internal phenomena of cell-division is added.

The process of regeneration in the earthworm is incorrectly, or at least very imperfectly, described. "The earthworm is not known to multiply by any natural process of agamogenesis. It possesses in a high degree, however, the closely related power of regeneration; for if a worm be cut transversely into two pieces the anterior piece will usually make good or regenerate the missing portion, while the posterior piece may regenerate the anterior region" (page 73). Rarely or never will this happen in the earthworm! If the anterior piece be sufficiently long, *i. e.*, if it contains more than 24 segments it may then regenerate posteriorly. But the corresponding posterior end will not under these conditions regenerate. A shorter anterior piece will not regenerate. A posterior piece having lost less than 15 anterior segments may regenerate and replace all or part of those lost.

Few and unimportant changes seem to have been added to the description of the structure and physiology of the fern.

The brief descriptions of the unicellular forms are most admirable and a most important addition has been made to the older volume. A statement in the chapter devoted to yeast calls for correction (page 188). "It was supposed for a long time by Pasteur and others that yeast could dispense with free oxygen in its dietary. It now appears that this faculty is temporary only." * * * Pasteur himself on the contrary has given the results of a most elaborate series of experiments to demonstrate that yeast *can not permanently* dispense with free oxygen in its dietary.

Chapter XVI on bacteria and Chapter XVII on 'a hay infusion' give in few words a thoroughly good summary of the part played by bacteria in the world's economy.

The first edition of the General Biology filled a unique place amongst our text-books and the new edition fulfills all the uses of the first edition. It brings the latter down to date and we venture to prophesy that it will meet with a hearty reception. The volume is a much-needed and most valuable addition to our best text-books. It is well printed and illustrated, and the descriptions of the authors are always clear and concise. T. H. MORGAN.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, NOVEMBER.

JACKSON and Grindley contribute further results of their work on the action of sodic alcoholates on chloranil. They describe the methods of preparation, properties and reactions of a number of acetals derived from substituted quinones.

Orndorff and Cameron find that the substance formed by the action of sunlight on anthracene in benzene, is dianthracene and not a paranthracene. They obtained the substance in pure condition and made a thorough crystallographic study of it. Interesting points of resemblance and difference were brought out by a comparison of the measurements of the axial ratios and angles. All attempts to bring about the transformation by any other method than that made use of failed.

Hitherto all the determinations of the molecular weight of paranthracene have been made by the freezing-point method. The vapor-density method could not be used, as paranthracene is converted into anthracene at its melting point (244°). The results obtained by the freezing-point method varied greatly, and were very unsatisfactory, on account of the slight solubility of the substance in all the solvents used. The authors find that, by the use of the boiling-point method, using pyridine, anisol and phenetol as solvents, good results can be obtained.

Campbell has prepared copper oxide containing a small amount of palladium, and finds that the combustion of gases takes place at a lower temperature when he uses this mixture than when the oxygen is introduced in the form of gas.

Kastle suggests the use of the dichlor deriva-

tive of benzene sulphonamide as a reagent for bromine and iodine, in the place of chlorine water. When metallic bromides or iodides are decomposed by this substance, in the presence of carbon disulphide or chloroform, the solvents are colored, as they are when chlorine water is used. The substance is very stable and the reaction is extremely delicate.

Kremers has studied the effects of solvents upon the rotatory power of limonene. In some cases, as the dilution increases, the rotatory power of the limonene diminishes. He also found that limonene monohydrochloride, when in contact with water in a sealed tube, was slowly charged to terpin hydrate.

By the action of bromine on metanitraniline, Wheeler obtained a substance in which the bromine is in the ortho position to the amido group. The nitro group influences the substitution in this case, for if aniline is treated with halogens, para and not ortho compounds are obtained. A number of derivatives of metanitraniline were made and studied. A review, of recent articles on the dissociation of electrolytes as determined by experiments on solubility, is contributed by Humphreys.

J. Elliott Gilpin.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES, BIOLOGICAL SECTION, NOVEMBER 11, 1895.

The following papers were presented:

Prof. H. F. Osborn: 'A Memorial Tribute to Prof. Thomas H. Huxley.'

Dr. Bashford Dean: 'Notes of the Ancestral Sharks.' In this paper Cladoselachids were reviewed, and for the first time the structural characters of their vertebral skeleton, integument and suspensorium were given; and together with these features was noted the lack of claspers, shown in a dozen well-preserved ventral fins, as significent of the fertilization conditions of these early sharks. In this regard these Lower Carbon forms would correspond to the usual ichthyic type (as of Teleostome or Lung-fish). The total absence of a pelvic girdle in these early forms is also significant.

Dr. Arnold Graf: 'A Peculiar Growth Character in Crepidula.' This paper recorded the adjustment of the shell of the Crepidula to that of a scallop, *Pecten*, the margin of the shell of the Crepidula conforming exactly to the ridged character of the shell of its host.

Bashford Dean,
Recording Secretary.

THE TORREY BOTANICAL CLUB.

At the regular meeting of the Club held on Tuesday evening, November 12. Prof. Emily L. Gregory, Ph. D., of Barnard College, presented an historical sketch of the *Theories of the Origin and Nature of the Starch Grain*, the relations of our present views concerning the nature of growth of organized matter to these theories being specially dwelt upon.

The systematic study of the subject began with Nægeli, and all subsequent contributions were either based upon his conclusions or took them for the starting point. He recognized the two substances, starch-cellulose and granulose as composing the starch grain, and described the phenomena of the appearance and disappearance of the latter and the transportation of its substance. He referred its origin to the chlorophyll-grain. Schimper subsequently pointed out the existence of the two other bodies, leucoplastids and chromoplastids and traced relations between the former and the starch grain. In all work up to and including that of Schimper, the accepted distinctions between unorganized and organized matter were such that the starch grain was taken as the type of the latter, and Schimper denominated it as crystalloid substance; that is, one which, though really organized, resembles a crystal in some particulars. Observations of the phenomena of the starch grain thus became the basis for theories concerning the growth of organized substances, of which the starch grain was taken as the type. Recently, however, Meyer has published a work reviewing the subject, and demonstrating, apparently, that it is not a crystalloid, but a true crystal, hence unorganized; so that all theories of the growth of organized substance, based on our ideas of the starch grain fall, and we must begin to study the subject *de novo* if Meyer's views are correct.

H. H. Rusby, *Rec. Sec.*

NATIONAL GEOGRAPHIC SOCIETY, REGULAR TECHNICAL MEETING, WASHINGTON, D. C., FRIDAY EVENING, NOVEMBER 15.

The meeting was devoted to the discussion of the subject of the hydrography of the United States, in which five Government officers engaged in that work took part.

Mr. F. H. Newell, in charge of the Division of Hydrography in the U. S. Geological Survey, referred to the hydrographic work done by the Government through the agency of the Coast and Geodetic Survey, the Hydrographic Office, the Engineers' Office of the Army, and one or two other organizations, and pointed out the difference between that work and the work of the Geological Survey, the work of the organizations first named having reference in the main to the interests of commerce, while that of the last named Bureau is for the purpose of obtaining data of value relating to land irrigation, water power, and the supply of potable water. He then discussed in general terms the important work that the Geological Survey is doing in this line, with the small appropriation that it has for the purpose, and the methods followed.

Mr. Newell was followed by Prof. Willis L. Moore, Chief of the Weather Bureau, who outlined the objects and methods of the work of the flood-forecasting division of his Bureau in forecasting floods on the principal rivers, giving instances of how the people in certain regions had been warned of approaching floods, and how many lives and millions of property had thus been saved. He referred to the limited scope of the work, due to lack of funds.

Prof. Moore was followed by Mr. A. P. Davis and Mr. Cyrus C. Babb, both of the Geological Survey, in charge of stream measurements in the West and in the South and East, respectively. Mr. Davis stated the conditions which had governed the location and selection of gauging stations, mentioning State and private coöperation, necessitated by demands of economy, and describing the hydrographic basins, etc. Certain railroads and irrigation companies, he said, are making systematic stream measurements in the West. Two States, Kansas and Colorado, are coöperating by devoting a small sum of money to the work. Mr. Babb similarly discussed the work done in connection with the streams of the Southern Appalachian region and on the Potomac. His work, which was begun but a few months ago, is the first of the kind yet done in the southern part of the country, and his paper was of particular interest.

The meeting closed with a paper by Mr. Marcus Baker, formerly of the Coast Survey, on the hydrography of the navigable waters, which was an interesting presentation of the subject from the point of view of navigation and commerce.

W. F. M.

GEOLOGICAL CONFERENCE OF HARVARD UNIVERSITY, NOVEMBER 5, 1895.

The Great Barrier Reef of Australia. By J. B. WOODWORTH. Mr. Woodworth spoke of the work of Mr. Saville Kent. A selection of about forty stereopticon views from the set of photographs of the great coral reef was shown. The views, it was pointed out, illustrated the way in which lowly-organized animals in coral seas take the place of plants, and even of inorganic debris on coasts like those of New England. The leafy alcyonarians grow attached to the bottom and act as the sea-weeds do in fending off the waves, and in harboring free crawling forms of marine life. The coral heads and blocks torn up by hurricanes take the place of boulders along the shore line. This reef further shows how great limestones, such as the Trenton and Corniferous of the North American palaeozoic sea, could have been made at no great distance from land. The great limestone-making zone is at sea level and a few feet below. The conditions now existing in the Great Barrier Reef, where islets and lagoons form, permit of the existence of land vegetation, and the record of various forms of shallow water and surface species in the midst of processes of limestone-making, which geologists have been accustomed to consider indicative of deep sea. It is now clear, as Dr. Murray has pointed out, that there are two great classes of marine calcareous deposits; those of the deep sea proper not developed in the continental areas, except locally, and those of a strictly continental type, of which the fossil reefs of the New York State system and the Grear Barrier Reef of Australia are past and present examples.

Notes on Geological Excursions. By W. M. Davis. 1. A brief description was given of an excursion made on October 26th with a party from the Teachers College, New York City, up the Hudson River Railroad to Fishkill, and thence by electric car and on foot to the summit of South Beacon Hill (1635), near the northern margin of the Highlands. The evenness of the sky-line was a notable feature of the view then obtained, the successive ridges reaching a much more equable altitude than, for example, in the Highlands of Scotland; although both regions are regarded as ancient lowlands, reduced to moderate relief by long-continued denudation, afterwards elevated and dissected. The Highlands of the Hudson are now advanced well towards mature variety of form in the present cycle of denudation, the valleys generally following an Appalachian trend, northeast-southwest. The view included the trench cut across the Highlands by the Hudson, an admirable example of a narrow transverse valley draining a wide inner longitudinal valley; the deepening of the inner valley was permitted only as fast as the trenching of the transverse valley advanced, but the widening of the inner valley proceeded rapidly because the rocks there are relatively weak, while the transverse valley is still narrow, inasmuch as the rocks in which it is sunk are extremely resistant. The movement of elevation permitting the dissection of the Highlands paused before their present altitude was reached, as is indicated by a more or less persistent bench about 150–200 feet above the present river level, first brought to the writer's attention by Mr. Gilbert. West Point is on this bench.

2. Some account was given of a two-day excursion, November 2d and 3d, with a party of Harvard students to the district about Meriden, Conn., where the contact of basal Triassic conglomerates on ancient schists in the gorge of Roaring Brook, Southington, the two lava beds of the Meriden quarries, and the oblique 2000-foot fault from Meriden to Berlin, were examined. The evidence of two cycles of topographical development was reviewed from the summit of West peak (1007 feet) in the Hanging hills. The crystalline uplands on the east and west represent a peneplain of Jurassic-Cretaceous denudation, now uplifted and dissected by narrow valleys of adolescent expression; the broad floor of the Triassic lowland between the crystalline uplands represent a local peneplain of late Tertiary denudation, here and there interrupted by narrow lava ridges. The crest line of Totoket Mountain, next to the southernmost of the eastern lava ridges, is notable for its evenness. Mount Carmel and the Blue Hills, an ancient volcanic neck north of New Haven, rise somewhat above the level of the adjacent crystalline upland. The inland facing escarpment, or *inface*, of Long Island rose faintly on the southern horizon; the stripped lowland between its inner base and the crystalline old land being now submerged in Long Island sound. The glacial striæ ascending the north slope of the West peak lava ridge for at least a mile, now freshly revealed along the road lately made to 'Percival Park' on the summit, are commended to the attention of those who hesitate to believe that ice sheets can move up hill. (An account of the double lava bed of the Meriden quarries will appear in a forthcoming number of the American Journal of Science.)

ACADEMY OF SCIENCE, ST. LOUIS, NOV. 18, 1895.

The Academy held its regular meeting at the Academy rooms, with President Green in the chair, and twenty-two members and visitors present.

Dr. Noah M. Glatfelter read a paper on 'The Relations of Salix Missouriensis Bebb, to Salix Cordata.' Dr. Glatfelter stated that Salix Missouriensis had been classed as a separate species by Mr. M. S. Bebb, but his own researches resulted in a different conclusion, his belief being that Salix Missouriensis was but a variety of Salix Cordata, and in same instances it was impossible for him even to detect the variety, the two being seemingly identical. Referred to the Council.

Mr. F. W. Duenkel presented a model of a meteorological instrument, invented by Mr. Leonard Hunt and himself, called 'The Electric Sunshine Annunciator,' and gave a brief explanation of its mode of operation, stating that it had been in use for a short time, but reported with accuracy the amount of sunshine each day.

A. W. Douglas, *Recording Secretary.*